CONFIDENTIAL

CONFIDENTIAL

FINAL REPORT ON

THE MARK II TIME DELAY

INTRODUCTION

The purpose of this contract was to improve the AC Time Delay. The AC Delay is a variable delay of two hours to two months. The primary objectives in the redesign were the following:

1. To improve the accuracy of the device.
2. To redesign the device so that it would be equally reliable in all positions.
3. If possible, to lower the temperature coefficient for each time delay.

The desired engineering characteristics for the unit were:

1. The unit should be as small and light as possible.
2. The unit should be rugged enough to withstand considerable rough handling.

[redacted] 25X1

4. The unit must be capable of storage at temperatures ranging from -60°F to +160°F.
5. The unit shall be operable at temperatures ranging from -40°F to +120°F.
6. The action of the unit must not be impaired by use in powdered solids, such as dusts, or immersed in water, gasoline, alcohol or other common solvents.
7. The unit must have a shelf life of 5 to 10 years.
8. The action of the unit should be position independent.
9. The unit must be capable of being armed easily using only one heavily gloved hand on the unit, under water, and in the dark.
10. The unit must be safe after it is armed for a definite period of time.

11. The unit must be liquid tight after it is loaded and before and after it is armed.

12. Metric threads and dimensions should be used wherever possible.

13. The unit should have a variety of time delays as independent of temperature as possible. The delays should be one hour, six hours, twelve hours, twenty-four hours, three days, one week, two weeks, four weeks and eight weeks.

Testing Jigs:

Testing jigs were designed specifically for use on this contract. Each testing jig contains an arrangement for the simultaneous testing of five units in any one position, measuring individually the activation times by means of a break-wire causing an electric clock stoppage, and the relative impact by means of a lead disk to take up and measure the impact of the striker pin.

The disk was calibrated by dropping weights upon it. (See appendix.)

Testing of the AC Delay:

The complete firing data for the AC Delays supplied by the client are listed in the appendix.

200 AC Delays were furnished by the client and a part of them were used for further testing of the unit.

The AC Delay was tested in the upright position (firing assembly downward) using red ampoules containing acetone. The results obtained were as follows:

	77° F
	4.2 hrs.
	4.3 hrs.
	4.3 hrs.
	4.5 hrs.
	4.7 hrs.
	5.0 hrs.
	5.4 hrs.
Mean	4.5 hrs.
Standard Deviation	0.44 hrs.

The results in the inverted position were as follows:

	77° F
	4.1 hrs.
	4.2 hrs.
	4.6 hrs.
	5.5 hrs.
	5.7 hrs.
	5.8 hrs.
	6.6 hrs.
Mean	5.2 hrs.
Standard Deviation	0.63 hrs.

It must be remembered that because of acetone's low viscosity and high vapor pressure, better wetting of the wicks should be expected and therefore less position dependency should be expected than when other solvents are used. Twelve of the twenty sealing gaskets were punctured by the breaking of the ampoules, causing leakage of the solvent when the device was inverted. This occurred even though great care was taken not to screw the thumb screw further than absolutely necessary and to unscrew it immediately after breaking the ampoules. note!

The AC Delay was tested in the upright position using black ampoules containing a 62.2% dimethyl phthalate, 37.8% n-butyl lactate mixture. The results obtained were as follows:

	106.2° F
	148.5 hrs.
	152.9 hrs.
	153.8 hrs.
	226.0 hrs.
Mean	170.3 hrs.

One unit did not fire.

The above results are in substantial agreement with the firing time data table.

The AC Delay was also tested in the upright position, using green ampoules. The results obtained were as follows:

	80° F
	12.6 hrs.
	13.6 hrs.
	14.0 hrs.
	14.1 hrs.
	14.2 hrs.
	14.5 hrs.
	14.5 hrs.
	14.6 hrs.
	15.0 hrs.
Mean	14.4 hrs.
Median	14.2 hrs.
Standard Deviation	1.4 hrs.
Coefficient of Variation	10%

25X1

	WITH WICKS AT 81°F	WITHOUT WICKS AT 81°F
	4 hrs. 01 min.	3 hrs. 25 min.
	4 hrs. 02 min.	3 hrs. 28 min.
	4 hrs. 09 min.	3 hrs. 31 min.
	4 hrs. 12 min.	3 hrs. 31 min.
	4 hrs. 18 min.	3 hrs. 32 min.
	4 hrs. 21 min.	3 hrs. 34 min.
	4 hrs. 29 min.	3 hrs. 40 min.
	4 hrs. 35 min.	3 hrs. 42 min.
	4 hrs. 45 min.	3 hrs. 50 min.
	4 hrs. 46 min.	4 hrs. 02 min.
Mean	4.4 hrs.	3.6 hrs.
Median	4.3 hrs.	3.5 hrs.
Standard Deviation	0.27 hrs.	0.16 hrs.

The following values for the observed force of impact show that the impact does very from one unit to another, but not in a manner which would greatly effect the time delay.

RED CAPSULE IN UPRIGHT UNIT	RED CAPSULE IN INVERTED UNIT
0.38 x 10^8 dynes	0.38 x 10^8 dynes
0.38 x " "	0.39 x " "
0.38 x " "	0.40 x " "
0.40 x " "	0.55 x " "
0.55 x " "	0.55 x " "
0.55 x " "	0.55 x " "
0.55 x " "	0.55 x " "
0.55 x " "	0.60 x " "
0.55 x " "	0.72 x " "
0.72 x " "	

UNITS WITH WICKS FILLED WITH ACETONE	UNITS WITHOUT WICKS FILLED WITH ACETONE	BLACK CAPSULES IN THE UPRIGHT POSITION
0.42 x 10^8 dynes	0.59 x 10^8 dynes	0.38 x 10^8 dynes
0.55 x " "	0.59 x " "	0.40 x " "
0.55 x " "	0.59 x " "	0.55 x " "
0.60 x " "	0.74 x " "	0.55 x " "
0.64 x " "	0.84 x " "	
0.74 x " "	0.93 x " "	
0.74 x " "	0.99 x " "	
0.74 x " "	1.07 x " "	
0.99 x " "	1.39 x " "	

Although some of the above values for the force of impact vary considerably, the coefficient of correlation between the results of the time delay and the impact of the units without wicks and filled with acetone is +0.055 which is considered negligible.

The results of testing the AC Delay suggests the following conclusions: note!

1. It would be desirable to eliminate the wick.

2. The comparison of results with and without wicks would indicate that reliable action of the device is dependent upon having no air space or bubble at the plastic solvent interface regardless of the position of the device.

3. Since the delay time appeared to have been considerably increased with the aging of the plastic, camphor should either not be used as a plasticizer or the plastic must be protected from gross losses of camphor.

4. The drag of the softened plastic upon the striker body is small.

5. Because of frequency of its rupturing, the rubber sealing disk should be eliminated.

6. The greatest possible improvement of the unit is, as far as increasing the reliability is concerned, the redesign of the capsule.

7. Normal (approximately 10%) differences in strength of the spring cause only small differences in the time delay.

It is therefore obvious that the major problem in this contract was to design a device in such a manner that there would be an uninterrupted plastic, solvent interface and that there would be no deterrent bodies in the way of diffusion from the interface.

Design of Capsule:

It was originally thought that the capsule could best be designed by using a metal bellows as a capsule body and a foil shearing seal which would be pierced by a protrusion extending over the screw disk. It was thought that the compression of the metallic bellows would insure an uninterupted plastic solvent interface. However, it was found that metal bellows were prohibitively expensive and were easily eliminated because the expansion and contraction of

the solvent could be accommodated by the flexing of a thin lead seal on the end of a rigid capsule. After twenty cycles between -70°F and +120°F, of such a capsule, filled with acetone, there were no apparent fatigue effects upon the lead seal. When the capsule was subsequently heated slowly, the lead seal did not rupture until a temperature of 185°F was attained. It was also found that the piercing of a hard foil shearing seal was impractical, and the sealing of such a capsule was very difficult.

A lead impact extruded shearing seal in the general form of a thin bottomed cup was designed and soldered onto a body machined from brass rod which had on it provisions for an "O"-ring. The "O"-ring would quite effectively seal the interior of the unit before and after arming as well as position the capsule inside the body. Several designs of the lead impact extruded shearing seal were tried including ones with projections to lift the broken slug of lead away from the screw disk and ones with stronger parts on one side to prevent complete shearing of the seal and subsequent falling of the lead back upon the screw disk, protecting it from the solvent. It was found, however, that if the interior diameter of the capsule were sufficiently large, a flat bottomed cup design containing no protrusions or strengthened parts was satisfactory.

The brass machined capsules were regarded as too heavy. It was then found that a brass rolled capsule could be made both ~~lighter, and~~ in large quantities considerably cheaper. The price estimates obtained from Western Brass Mills, a subsidiary of Olin-Mathieson Corporation, after an initial tooling charge of $1,200.00, in lots of 10,000, 100,000, 250,000, 500,000 and 1,000,000 were $89.80/M, $50.45/M, $47.80/M, $46.65/M and $45.95/M respectively. For screw machined capsules, the tentative prices in lots of 10,000, 100,000, 500,000 and 1,000,000 are $156.15/M, $119.50/M, $116.95/M, $116.65/M, and $116.65/M respectively. Therefore, including tooling, after 20,000 capsules have been manufactured, the rolled capsule becomes cheaper. The rolled capsule, also has the advantage of light weight, which will lessen the possibility of the capsule breaking when dropped in an unarmed unit in the upright position. However, it has the disadvantage that the "O"-ring groove can only be held to five times the normal tolerances for such grooves.

Models of the capsule were tested with the smallest expected groove in the largest expected body and the largest expected groove in the smallest expected body. No signs of water seepage were found after the models were submerged for three days.

The capsules could be sealed by drilling a hole not larger than 0.025" in diameter through the solid end of the capsule. The capsule could then be filled using a hypodermic needle and solder which had been previously placed upon the end of the capsule could then be pounded over it to close the hole. Alternatively, a production method using a tapered lead plug could probably also be used satisfactorily.

It was found that the best easily available material for manufacture of the "O"-ring is Thiokol. This material is sufficiently resistant to the solvents used for use in this device. However, brass after long periods of time has a catalytic effect upon rubber and rubber substitutes causing them to deteriorate. This deterioration may be avoided by lacquering the "O"-ring groove of the capsule. The lacquering if properly done can perform two additional functions: (1) It can identify one capsule from the other and, (2) If painted only up to a certain point on the capsule, it may be used as a guide showing how far to push the capsule into the body of the unit during the pre-arming assembly.

Redesign of the Striker Assembly:

Using a striker pin with a tapered head similar to the one used in the AC Delay, erratic results were obtained as follows:

98°F
55 min.
56 min.
65 min.
69 min.
76 min.
83 min.
96 min.
100 min.
124 min.
125 min.
128 min.

It was postulated that since the time delay using acetone had become longer with storage of the device and its accuracy had improved, that the head of the striker pin had cold-flowed itself into position in the plastic of the screw disk. Previous to the "cold-flow" process, the solvent had been able to penetrate cracks and crevices between the screw disk and the head of the striker pin causing shorter and inaccurate time delays. An additional problem, therefore, was the design of a head for the striker pin

which would be more accurate immediately after manufacture. However, it seems very doubtful that a head which would be unaffected by aging is possible.

Various striker pin head designs were tried and rejected. These included flat heads, heads with knife edges, heads with "O"-rings and heads with washers. All of these types of striker pins produced erratic results.

It was then postulated that besides the leadage around the head of the striker pin there were two possible reasons for erratic results: (1) The tension on the screw disk caused it to be distorted. (2) The downward pull of the head of the striker pin varied from unit to unit. It was therefore decided to design the unit in such a way that the sealing of the head of the striker pin on the screw disk would be independent of the downward pull on the disk. This was done very easily by extending the striker body's neck the same diameter as the head of the striker pin's head, up to the bottom surface of the screw disk. The sealing action then became one of compression rather than one of downward pull. Using the knife edged striker pin head supported as stated, the results were still erratic. However, there was no sign of leakage around the head of the striker pin. It was discovered, however, that removing the excess downward pull from the screw disk had allowed the solvent to seep underneath the screw disk from the outside edge of the disk. Furthermore, a large amount of plastic was pulled into the spring area by the head of the striker pin and there were frequent failures because the head of the striker pin would catch on the edge of the hole leading to the spring chamber. These failures were eliminated by simply tapering the hole into the spring chamber.

note! Lack one design of MMR

The leakage of solvent underneath the screw disk and the pulling of excess plastic through the hole to the spring chamber were eliminated by screwing a retainer over the plastic disks. The retainer seals against the top surface of the screw disk by means of a knife edge. Good results were obtained using this arrangement.

check one design on this

In the AC Delay there is a considerable loss of tension of the spring after several months' storage. A large portion of this loss can be avoided by the use of a shot-peened and stress relieved spring. To make the spring more able to retain its nominal characteristics after standing for a period of several years under tension, it was redesigned according to the recommendations of the Muelhausen Spring Div., making the coil larger. This has the disadvantage of requiring the small bore of the body to be reemed out, thereby making the walls of the small bore thinner but this is not of great consequence; however, to reduce the

amount of space between the spring and the walls of the body which is required, a small edge was placed on the end of the flange on the bottom of the striker body and the striker body was made full round at this flange with a screw slot rather than with flats for wrenches. This change prevents the spring from expanding out around the flange of the striker body therby causing a failure.

Considerable corrosion of the internal parts in the AC Delay has been reported. Corrosion of the spring has been prevented by using a cadmium plate rather than a zinc plate in the redesigned unit. However, since the dimensions of the head of the striker pin and the knife edge of the retainer must be held closely, neither zinc, which also does not protect sufficiently, or cadmium plate is recommended. Therefore, chrome plate is recommended. The head of the striker pin is centerless ground to the proper dimensions after chrome plating. ____ check this

25X1

The "O"-ring on the capsule makes unnecessary an other sealing of the unit. Therefore, no sealing disk is necessary.

Since the unit will be die-cast and since the possibility of leakage from the striker pin end of the body of the unit should be avoided, the part known as the shearing insert in the AC Delay is made an integral part of the body.

To prevent leakage of the solvent out of the capsule into the empty space of the interior of the body a large, rather dull knife edge has been placed on the floor of the large part of the body where the lead shearing seal of the capsule comes to rest.

A small chamfer was placed on the interior of the end of the large wall of the body. This is to permit easy "O"-ring entry into the body.

Since the sealing of the cap to the body is not necessary, the thumb screw was eliminated and a simple cap which screws down all the way was substituted. This simple cap arrangement has the following advantages: (1) It is shorter; (2) It is cheaper to manufacture; (3) It permits easy screwing of the unit into the detonator by means of the cap; (4) It permits the unit to be more conveniently placed in and removed from clothing; (5) It permits easier arming since full arm movements are possible rather than just movements of the fingers.

Metric threads and dimensions have been used throughout the body and the cap with the exceptions of the sections of the body which normally fit into existing incendiary or detonating units thereby preventing changes in dimensions. The interior of the body was also made even in round numbers in the English system of measurements since that dimension is determined by the "O"-ring which is used. The use of a metric measurement would make necessary the use of a special "O"-ring, thereby causing considerable unnecessary tooling charges.

Work on Solvents:

It has been shown by Doolittle, (Ind. and Eng. Chem., 38, 535 (1946)), that heavier solvents, diluted with non-solvents such as toluene or n-heptane, are more active at lower temperatures, compared to their activities at higher temperatures. Consequently, a series of experiments were undertaken using the heavier solvents diluted with toluene or n-heptane. It was found, however, that although the solubility may be increased at low temperatures for some of these mixtures that when there is an increase of the solubility upon lowering the temperature, there is no accompanying increase of the rate of solvation.

Using 2-heptanone as the solvent, the average firing time is 12.0 hours at 100°F and more than 144 hours at 40°F.

Using 4-methyl-2-pentanone as the solvent, the average firing time is 9.8 hours at 100°F and 90.0 hours at 40°F. The ratio of firing times is therefore 7.5.

Using acetoacetic ester, the average firing time at 100°F is 21.5 hours and more than 168 hours at 40°F.

When these results are compared with the firing times of the AC Delay, the temperature dependency of 2-heptanone, 4-methyl-2-pentanone and acetoacetic ester are found to

be slightly greater than n-butyl acetate (green ampoule), n-propyl acetate (yellow ampoule) and n-amyl acetate (blue ampoule), respectively.

The fact that the rate of solvation is not proportional to the solubility of one solvent at varying temperatures is not surprising since the rate of the solution process is mainly dependent upon diffusion rates and diffusion rates are dependent upon the velocity of the molecules of the solvent. Since the velocity of the molecules are, of course, slower at low temperatures, the rate of solution should therefore be slower. Also, at one given temperature the kinetic energies of solvents of different molecular weights are approximately equal and since this energy is equal to one-half the molecular weight times the square of the root mean square velocity of the molecules, it is obvious that the lighter solvents will then have a much faster molecular velocity. It was therefore decided to investigate active solvents such as acetone diluted with toluene. The following results indicate that as would be expected, the temperature dependency did not increase greatly with decreasing concentration of the solvent in these mixtures.

Using an 80% acetone, 20% toluene mixture as the solvent, average values of 1.3 hours at 100°F and 4.2 hours at 40°F were obtained; the ratio is 3.2 hours.

Using a 40% acetone, 60% toluene mixture as the solvent, average values of 52 hours at 100°F and 14.2 hours at 40°F were obtained. The ratio of firing times is therefore 2.7. When these values are compared with the solvents used in the AC Delays, they are found to be much less temperature dependent.

However, these results were obtained in a special series of experiments using a plastic disk plasticized with tricresyl phosphate. When a plastic using camphor was tried with these diluted mixtures, a large number of misfires were observed. It was found that when equal quantities of methanol and toluene were used as diluents, satisfactory results were obtained. However, these mixtures have no advantage over pure solvents.

To study the effect of inert contaminants in the pure solvents, additional time delay values of acetone, toluene mixtures at 100°F were obtained. The results are as follows:

% ACETONE	TIME DELAY (IN HOURS)
100	0.95
80	3.0
60	4.0
40	4.9
10	25.0

These results indicate that using "pure" solvents a 5% inert contaminant should not be of great consequence.

The solvents finally chosen were the following:

TIME DELAY (NOMINAL)	SOLVENT
1-1/2 hrs.	Acetone
6 hrs.	n-Propyl acetate
12 hrs.	n-Butyl acetate
24 hrs.	97% iso-amyl acetate, 3% ethyl acetate
48 hrs.	Ethyl lactate
4 days	n-Butyl lactate
1 week	62.2% dimethyl phthalate,37.8% n-butyl lactate
1 month	83.4% dimethyl phthalate,16.6% n-butyl lactate
42 days	99% dimethyl phthalate, 1% n-butyl lactate

These solvents differ from those used in the AC Delay only in the elimination of a capsule using ethyl acetate and substitution of a 97% iso-amyl acetate, 3% ethyl acetate mixture for the n-amyl acetate used in the AC Delay. The solvents used were of the following purity:

SOLVENT	SOURCE AND GRADE
Acetone	Mallinckrodt's Analytical Reagent
Ethyl acetate	Mallinckrodt's Analytical Reagent
n-Propyl acetate	Fisher's Purified
n-Butyl acetate	Fisher's Reagent
Iso-amyl acetate	Fisher's Certified
Ethyl lactate	Fisher's Highest Purity
n-Butyl lactate	Fisher's Highest Purity
Dimethyl phthalate	Monsanto U. S. P.

These sources and grades represent the highest purity of these solvents that is now commercially available. The n-propyl acetate, n-butyl acetate, ethyl lactate and n-butyl lactate are equivalent to those specified for the AC Delay. The dimethyl phthalate is identical to that used in the AC Delay. The acetone and the ethyl acetate specified are of considerably higher purity than specified for the AC Delays. It is immediately obvious that the acetone, ethyl acetate, iso-amyl acetate and dimethyl phthalate

should be of high and uniform quality. However, the n-propyl acetate, n-butyl acetate, ethyl lactate and n-butyl lactate meet no accepted specifications. It was, therefore, not surprising that using one sample of ethyl lactate, a time delay approximately one-third that of normal was obtained. Thirty percent of this sample was found to be low boiling. For comparison, the acceptable material was distilled. All of this material boiled in the acceptable range of 150-152°C.

It is immediately obvious that a standard purification procedure or at least a very closely controlled distillation must be used. A distillation through a column capable of maintaining a 1°C differential should be adequate. However, more than just a boiling range is required on these four solvents for a control of quality.

When we examine the refractive indices and the specific gravities of the acetates and possible contaminants, we find that neither can be certain of determining these contaminants when present in quantities less than 10%. When we examine the infra-red spectrum we find that the absorption maxima for ketones, aldehydes, and acids could not be resolved from the maxima caused by the carbonyl group of the ester. Furthermore, in low concentrations, only the most elaborate and expensive apparatus could resolve the maxima in the "fingerprint" region. The hydroxyl group in any alcohols in the acetates present could readily and accurately be determined using infra-red methods, however, a simple permanganate test would be satisfactory. Therefore, classical chemical methods only should be employed.

Since we have found that a 5% inert contamination is not of great consequence, a saponification equivalent from 95-105% would be adequate. The hydroxyl group and the carbonyl group contamination in the acetates can be determined by a permanganate decolorization test. There should be no more than 4% contamination when the contamination is calculated as an alcohol of the same molecular weight as the solvent.

The refractive indices will suffice for proving freedom from excess carbonyl and hydroxyl contamination in the lactates.

The above tests would be sufficient for the quantitative determination of the possible contaminants, but would not insure against incorrect or misleading packaging or labeling. Therefore, a boiling range of both the alcohol and acid liberated during saponification should be undertaken

as well as the preparation of at least two identifying derivatives of each.

Work on Plastics:

In considering the type of nitrocellulose plastic to be used in this delay, the first consideration was that of the nitrocellulose itself. It had been found that the solubility of nitrocellulose plastics in many solvents varies considerably with differences in nitrogen content of the nitrocellulose. The limits of variation of nitrogen content were therefore changed to ±0.1%. It is to be noted, also, that a mixture of two nitrocellulose samples containing differing amounts of nitrogen will dissolve somewhat like two different compounds rather than as an average of the two. Therefore, it was recommended that the nitrocellulose used, be of a single nitration batch or, be of a composite of two or more batches whose compositions do not vary more than 0.1% in nitrogen content from each other; furthermore, the viscosity of the nitrocellulose must be specified.

When a plastic disk was lightly touched with oil before use, it was found that strikingly longer and unreproducible results were obtained. This is consistant with previous experience with nitrocellulose plastics. Therefore, at no time during the machining or inspection, of the screw disks, should the plastic come in contact with oil, grease, cutting agents, soluble cutting oils, starches, resins or soaps.

Camphor has been considered a poor plasticizer for nitrocellulose used in such devices because of the loss of camphor during storage over a period of years, therefore, other plasticizers were investigated. It was found the only commercially available nitrocellulose plasticized mistures other than camphor is nitrocellulose with tri-cresyl phosphate. However, it is of greater importance to insure the reproducibility of the plastic and to insure its homogeneity. Extruded rods are considered the best form of plastic for this device. It is not possible at this time to obtain nitrocellulose in the form of extruded rods plasticized with tri-cresyl phosphate. When sheet was used, a coefficient of correlation of +0.74 was found between the force of impact and the time delay, indicating the heterogenous nature of the plastic. Furthermore, since the tri-cresyl phosphate/nitrocellulose plastic is harder, a thinner disk would have to be used. Since it has been shown that the time delay varies with the square of the thickness, it was decided that the machining difficulties in machining a thin

plastic disk to adequate tolerances, made its use impractical. However, since an equilibrium will be reached quickly, it is possible to seal the device in such a way as to eliminate gross losses of camphor. It is therefore possible to maintain a uniform state of the finished article when camphor is used as a plasticizer. A nitrocellulose camphor plastic was chosen.

It was decided, since the rod must be at some time screw machined during the manufacture of the disks, that the nitrocellulose be given a 60-day curing time rather than the 30-day curing time before the initial machining. To stabilize its dimensions, it will first be rough machined then allowed an additional 30-day curing time before the final machining.

Since it is necessary to quickly arrive at a fairly constant state in regards to moisture content of the plastic, the seasoning used in the manufacture of the disks for the AC Delay at elevated temperatures and humidities has been used.

It has been found experimentally that the time delay, using one solvent and one plastic, at a given temperature, varies as the square of the thickness of the plastic disk. This is not surprising since the approximate equation can be derived mathematically. This deviation is given in the appendix.

Packaging:

Since the camphor in the plastic must be allowed to create an equilibrium between the atmosphere and the plastic, both the can and the unit must be sealed in such a way as to prevent the camphor atmosphere from coming into contact with any packaging material which could act as a camphor "sump". It was originally thought that a preformed plastic sponge could be used, but it was found by experiment that camphor is absorbed readily by both polyethylene and polyvinyl chloride plastics. It was therefore decided that a metallic foil type bag would be acceptable, backing it with cotton. The best type of bag would be one employing two thicknesses of foil, but because of such a bag's prohibitive cost, a bag of a single foil thickness is recommended.

The can itself shall be rectangular and key opening. George D. Ellis & Sons, Inc., supplied the following quotation:

LOT	PRICE
1,000	$199.00/M
5,000	$179.00/M
10,000	$177.00/M
25,000	$175.00/M

However, an additional charge will be made to insert collars so that the can, once opened, can be resealed with tape. This charge will be $50-$100/M. The total price of cans with collars in lots of 1,000 is quoted as $332/M.

There was no apparent reason for changing the shipping container.

Safety Clip:

Since it is impossible to put a hole through the body of the unit itself, a wrap-around clip-type safety must be used. This was found a simple problem and was solved readily by corrugated strap metal bent to a shape which will clip around the body, preventing the cap from screwing down.

Material and Paint:

Since this device may at some time in the near future be made from magnesium, a paint which is also suitable for magnesium should be used. Therefore, the paint which is now being used successfully on the P-Unit has been specified. If, in the future, an injection molded unit of nylon, which may or may not be given a thin coating of teflon is used, no painting would be necessary for the body and cap.

Training Device:

It was requested that a training device having a delay time of approximately 15 minutes be developed for use with this item and that such a device be as similar to the delay device as practicable. Experiments have shown that a change of disk thickness from 2-1/2 millimeters to 1 millimeter using acetone as the solvent will give such a delay. The only part besides the disk which needs changing is the retainer. The thread length on this must be shortened. A light blue paint has been recommended for this device since this is the standard color for training units. Since it is anticipated that this device might be used at night-time, a stripe of radioactive phosphorescent paint is added to the cap and a large yellow letter "T" shall be painted on the end of the cap.

Testing of the Unit:

The results of the testing of the redesigned units are given below:

It must be remembered, however, that the reliability of an aged, mass produced, delay should be considerably better, since a constant state of the plastic would exist and the parts themselves, would be more uniform, as well as would their assembly.

Furthermore, a comparison of some of the results in different positions indicate that the standard deviation and coefficient of variation cast an exaggerated deprecatory inference upon the unit. In these cases, if one examines the mean values and the total range in both positions, one finds them virtually identical. The greater standard deviation and coefficient of variation values are therefore caused by the distribution of delay times within the range. Although this would make the probability of the units' firing precisely on the mean much less (provided that this distribution difference were supported by more values), it has little or no effect on the ultimate practical application of the unit since the delay ranges are of prime practical importance. In general, it may be said, however, that the position of the unit does not have gross effects upon its operation.

Tests in the upright position using acetone:

	104°F	77° F	41°F
	68 min.	92 min.	242 min.
	72 min.	92 min.	263 min.
	74 min.	95 min.	293 min.
	77 min.	95 min.	304 min.
	83 min.	98 min.	326 min.
	84 min.	101 min.	332 min.
	88 min.	104 min.	345 min.
	88 min.	114 min.	346 min.
	89 min.	116 min.	359 min.
	91 min.	128 min.	
Mean	81 min.	104 min.	318 min.
Median	83.5 min.	99.5 min.	326.5 min.
Standard Deviation	7.3 min.	10.2 min.	31 min.
Coefficient of Variation	9.0%	9.8%	9.8%

Tests in the horizontal position using acetone:

	104°F
	55 min.
	67 min.
	68 min.
	71 min.
	75 min.
Mean	67 min.

Tests in the inverted position using acetone:

	104°F	77°F	41°F
	55 min.	75 min.	542 min.
	65 min.	83 min.	567 min.
	66 min.	89 min.	687 min.
	67 min.	97 min.	
	68 min.	99 min.	
	68 min.	101 min.	
	80 min.	102 min.	
	89 min.	106 min.	
		107 min.	
		115 min.	
Mean	70 min.	98 min.	
Median	67.5 min.	100 min.	
Standard Deviation	9.6 min.	11.8 min.	
Coefficient of Variation	13.8%	12.0%	

Tests in the upright position using n-propyl acetate:

	104° F	77° F	41° F
	232 min.	304 min.	17.6 hrs.
	281 min.	310 min.	18.8 hrs.
	282 min.	324 min.	19.5 hrs.
	288 min.	326 min.	20.0 hrs.
	292 min.	361 min.	20.0 hrs.
	292 min.	383 min.	21.0 hrs.
	294 min.	391 min.	21.1 hrs.
	296 min.	401 min.	21.2 hrs.
	317 min.	407 min.	21.5 hrs.
	347 min.	430 min.	22.9 hrs.
		438 min.	
Mean	292 min.	352 min.	20.4 hrs.
Median	292 min.	383 min.	20.5 hrs.
Standard Deviation	7.3 min.	52.1 min.	1.51 hrs.
Coefficient of Variation	9.0%	14.8%	7.4%

Tests in the inverted position using n-propyl acetate:

104° F	77° F	41° F
194 min.	182 min.	22.5 hrs.
202 min.	187 min.	22.6 hrs.

	211 min.	247 min.	24.0 hrs.
	212 min.	370 min.	38.3 hrs.
	214 min.	410 min.	40.3 hrs.
	215 min.	420 min.	
	216 min.	460 min.	
	238 min.	540 min.	
	246 min.		
	249 min.		
Mean	220 min.	352 min.	29.5 hrs.
Median	214.5 min.	390 min.	
Standard Deviation	18.4 min.	96.2 min.	
Coefficient of Variation	8.5%	30.1%	

Tests in the upright position using n-butyl acetate:

	104° F	77° F	41° F
	4.8 hrs.	10.4 hrs.	47.0 hrs.
	5.7 hrs.	10.5 hrs.	47.5 hrs.
	5.8 hrs.	10.9 hrs.	48.4 hrs.
	6.2 hrs.	10.9 hrs.	52.0 hrs.
	6.6 hrs.	11.5 hrs.	52.6 hrs.
	6.7 hrs.	11.7 hrs.	
	6.8 hrs.	11.8 hrs.	
	7.0 hrs.	12.1 hrs.	
	7.2 hrs.	12.6 hrs.	
	7.9 hrs.	12.8 hrs.	
		13.4 hrs.	
Mean	6.5 hrs.	11.7 hrs.	49.5 hrs.
Median	6.8 hrs.	11.7 hrs.	
Standard Deviation	0.7 hrs.	0.93 hrs.	
Coefficient of Variation	14.0%	7.9%	

Tests in the inverted position using n-butyl acetate:

	104° F	77° F	41° F
	4.8 hrs.	12.0 hrs.	41.1 hrs.
	5.2 hrs.	13.3 hrs.	44.6 hrs.
	5.5 hrs.	14.3 hrs.	49.3 hrs.
	5.6 hrs.	14.4 hrs.	55.1 hrs.
	6.4 hrs.	14.5 hrs.	58.0 hrs.
	8.1 hrs.	17.3 hrs.	
	8.1 hrs.	18.1 hrs.	
		18.2 hrs.	
		18.7 hrs.	
		19.6 hrs.	
Mean	6.2 hrs.	16.0 hrs.	49.6 hrs.
Median	5.6 hrs.	14.6 hrs.	
Standard Deviation		2.61 hrs.	
Coefficient of Variation		16.3%	

Tests in the upright position using a 97% iso-amyl acetate 3% ethyl acetate mixture:

	104°F	77° F
	8.2 hrs.	20.8 hrs.
	8.8 hrs.	21.5 hrs.
	8.9 hrs.	22.3 hrs.
	9.1 hrs.	22.9 hrs.
	10.2 hrs.	23.3 hrs.
	10.5 hrs.	23.4 hrs.
	11.4 hrs.	24.4 hrs.
	11.4 hrs.	24.6 hrs.
	12.7 hrs.	25.2 hrs.
	13.4 hrs.	25.4 hrs.
		32.1 hrs.
		32.2 hrs.
Mean	10.5 hrs.	24.8 hrs.
Median	10.2 hrs.	24.5 hrs.
Standard Deviation	1.75 hrs.	3.69 hrs.
Coefficient of Variation	16.6%	14.9%

Tests in the inverted position using a 97% iso-amyl acetate, 3% ethyl acetate mixture:

	104°F	77° F
	7.7 hrs.	19.1 hrs.
	8.1 hrs.	20.4 hrs.
	8.8 hrs.	21.3 hrs.
	9.0 hrs.	21.5 hrs.
	11.4 hrs.	23.8 hrs.
	12.2 hrs.	24.9 hrs.
	12.7 hrs.	27.0 hrs.
	12.9 hrs.	27.5 hrs.
	13.4 hrs.	30.4 hrs.
	14.1 hrs.	
	14.2 hrs.	
Mean	11.7 hrs.	24.0 hrs.
Median	12.2 hrs.	23.8 hrs.
Standard Deviation	4.13 hrs.	3.80 hrs.
Coefficient Variation	35.4%	15.8%

Tests in the upright position using ethyl lactate:

104°F	77° F
30.8 hrs.	38.1 hrs.
32.4 hrs.	39.5 hrs.
32.8 hrs.	41.4 hrs.
33.1 hrs.	41.7 hrs.
33.7 hrs.	42.2 hrs.
37.8 hrs.	44.0 hrs.

		46.2 hrs.
		46.9 hrs.
		47.7 hrs.
		49.2 hrs.
		51.4 hrs.
		51.8 hrs.
Mean	33.4 hrs.	45.8 hrs.
Median		45.1 hrs.
Standard Deviation		3.31 hrs.
Coefficient of Variation		7.2%

Tests in the inverted position using ethyl lactate:

	104°F	77° F
	22.4 hrs.	40.5 hrs.
	24.5 hrs.	41.1 hrs.
	34.0 hrs.	42.0 hrs.
	34.2 hrs.	45.8 hrs.
	34.4 hrs.	46.8 hrs.
	38.2 hrs.	49.0 hrs.
	40.0 hrs.	49.3 hrs.
	44.2 hrs.	
	47.5 hrs.	
	48.0 hrs.	
Mean	35.9 hrs.	44.9 hrs.
Median	36.3 hrs.	
Standard Deviation	8.76 hrs.	
Coefficient of Variation	24.8%	

Tests in the upright position using n-butyl lactate:

	77° F
	80.3 hrs.
	80.7 hrs.
	81.9 hrs.
	82.0 hrs.
	85.3 hrs.
	87.4 hrs.
	91.1 hrs.
	97.2 hrs.
	98.4 hrs.
Mean	83.2 hrs.
Median	86.4 hrs.
Standard Deviation	5.32 hrs.
Coefficient of Variation	6.4%

Tests in the upright position using a 62.2% dimethyl phthalate, 37.8% n-butyl lactate mixture as the solvent:

77° F	41°F
8.3 days	50.00 days
11.3 days	54.8 "
11.5 days	58.0 "
	126.0 "
	132.0 "

163 d.
172
176 Mean 154
130
129 Median 163

Tests in the upright position using a 83.4% dimethyl phthalate, 16.6% n-butyl lactate mixture:

104°F	77° F	41°F
12.5 days	28.9 days	153
12.8 days	29.2 days	189
19.5 days	30.2 days	147
21.0 days		147
		156+314

Mean 184
Median 154

Tests of the training unit in the upright position using acetone:

77° F
16 min.
16 min.
17 min.
20 min.

Drop tests were conducted on the AC Delay and on the Mark II Delay in order to determine the relative shock resistance of both types of capsules. In all cases the units were dropped upon a steel plate. Ten trials were made unless otherwise stated. The units fell on the side in free fall and were channeled through a piece of pipe for tests in A1, A2 and in B1 and B2.

A. Drop tests on AC Delay.

1) Upright position

a) 0% at 42 inches
b) 50% at 100 inches

2) Inverted position

a) 0% at 42 inches
b) 60% at 100 inches

3) Side position

a) 50% at 42 inches
b) 85% at 100 inches (20 trials)

B. Drop Tests on the Mark II Unit.

1) Upright position

a) 0% at 42 inches
b) 100% at 54 inches

2) Inverted position

Only slight deformation of the capsule seal was observed after ten falls of 100 inches.

3) Side position (free fall)

No apparent effect on the capsule seal after ten falls of 120 inches.

The drop tests show that some AC Delay capsules will break during a drop which will break no Mark II capsules. Although some AC Delay capsules can withstand drops which no Mark II capsules can withstand when the units are dropped in the upright position, it must be noted that the upright position is a very improbable position for the unit to fall. The tests in the probable positions show that the Mark II capsules in practice are effectively much stronger than those of the AC Delay. Furthermore, these tests were performed using capsules machined from brass rod. The final model, because of its light weight, should withstand greater falls in the upright position.

Conclusions:

1. The unit has been shown to be more reliable than the AC Delay.

2. It is shown to have no great differences in time delay from one position to another.

3. It is found impractical to change the solvents in such a way to greatly influence the temperature dependency of this unit.

4. It is approximately the same diameter as the AC Delay but is considerably shorter. However, because of its metal capsule it is slightly heavier.

5. Drop tests of the unarmed unit have shown it to be slightly more rugged than the AC Delay.

6. Since neither the striking force nor the threads have been changed, the new unit will be capable of use with the M-34 detonator and with incendiary heads.

7. It should be possible to safely store this unit at temperatures ranging from -60°F to +140°F.

8. It should be possible to use the unit at temperatures at least as high as 135°F and at least as low as possible for the AC Delay.

9. Since the unit itself is fully sealed when in use, dusts, seawater, gasoline, alcohol and other common solvents should have no effect upon it.

10. The shelf life of the unit is restricted only by the shelf life of the nitrocellulose used.

11. Because of the clip type safety and the solid cap, it could easily be armed in the dark under water and with gloves using only one hand.

12. Since the unit's reliability is much improved, it is safe after it is armed for a period of time.

13. Metric threads and dimensions have been used wherever possible.

14. Time delays of 1-1/2 hours, 6 hours, 12 hours, 24 hours, two days, four days, two weeks, one month and 42 days have been achieved.

15. In the instruction sheets for this unit, it should be specified that before arming, the capsule should be pushed in no further than the painted strip on the capsule.

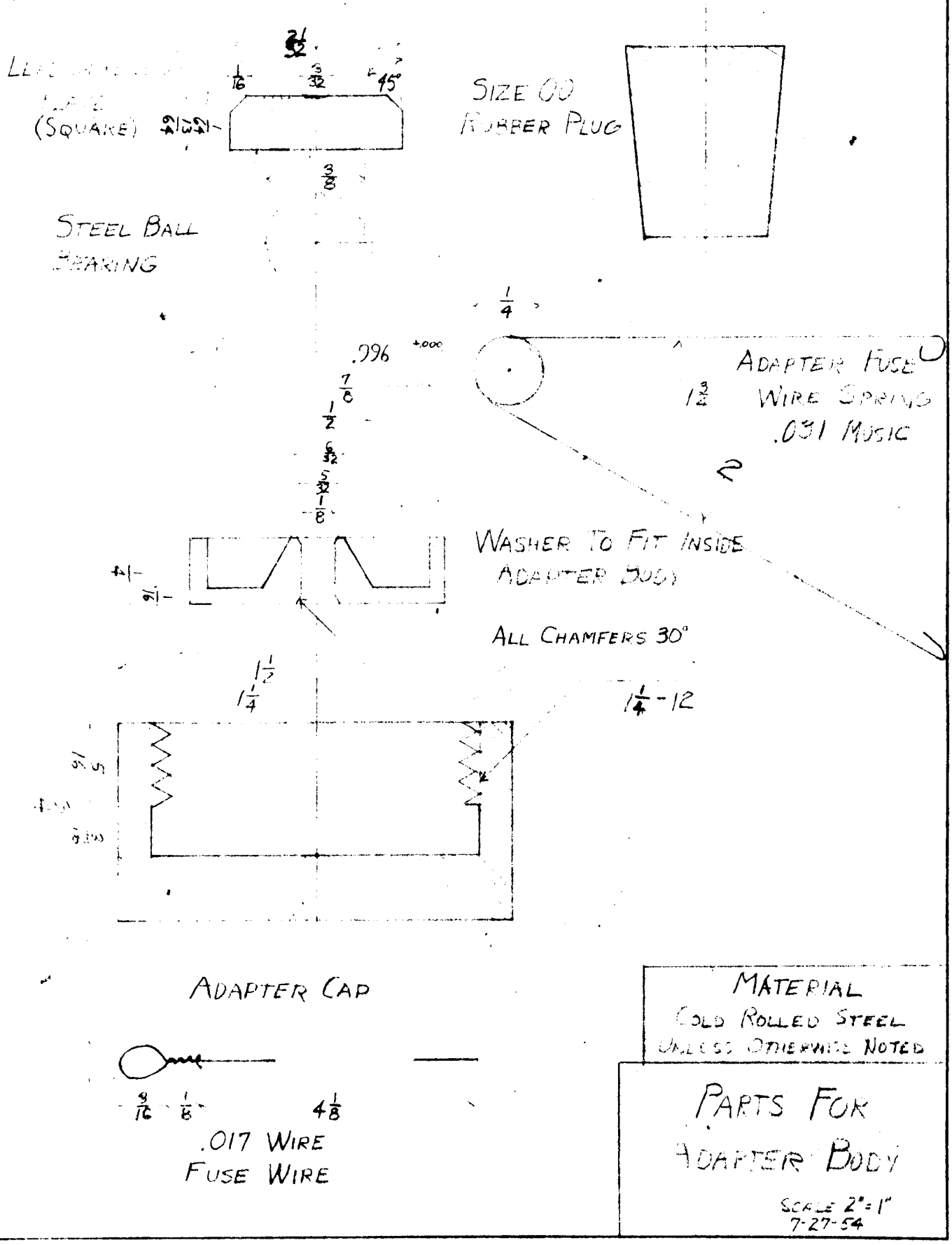
16. It should also be stated in the instruction sheet that whenever possible, the unit should be armed with the firing pin end upward.

APPENDIX

I Testing Jig Drawings

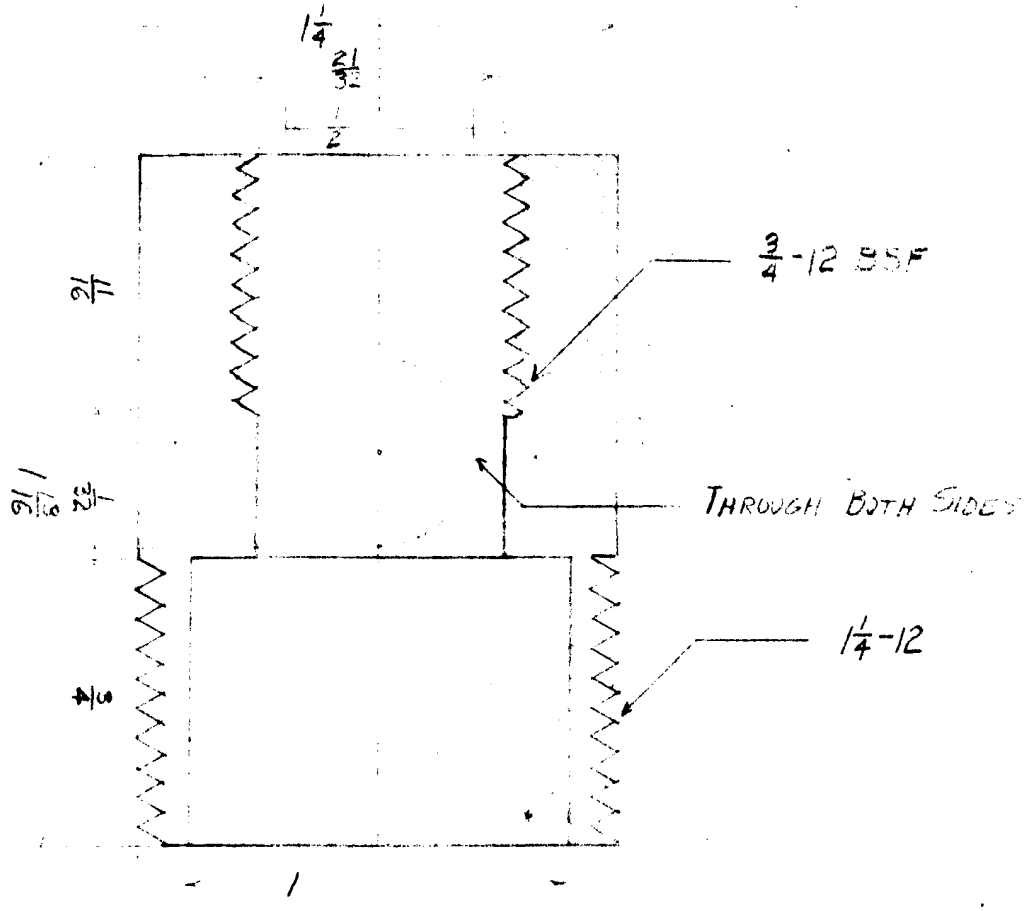
PREPARED
CHECKED
REF

PAGE 27 REV.
REPORT
DATE



PREPARED
CHECKED
REF

PAGE 28 REV
REPORT
DATE

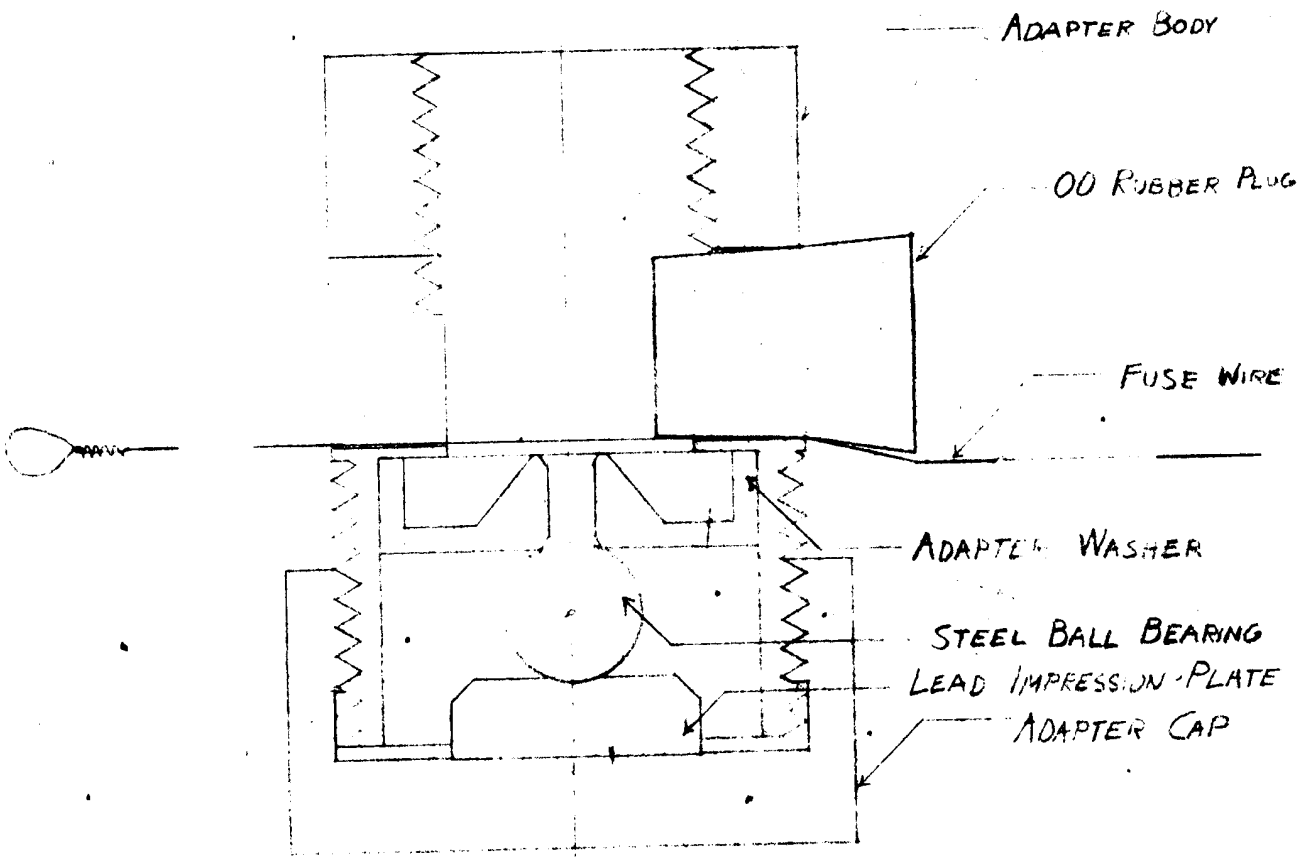


MATERIAL
COLD ROLLED STEEL

ADAPTER BODY

SCALE 2:1
7-27-54

PREPARED
CHECKED
REF

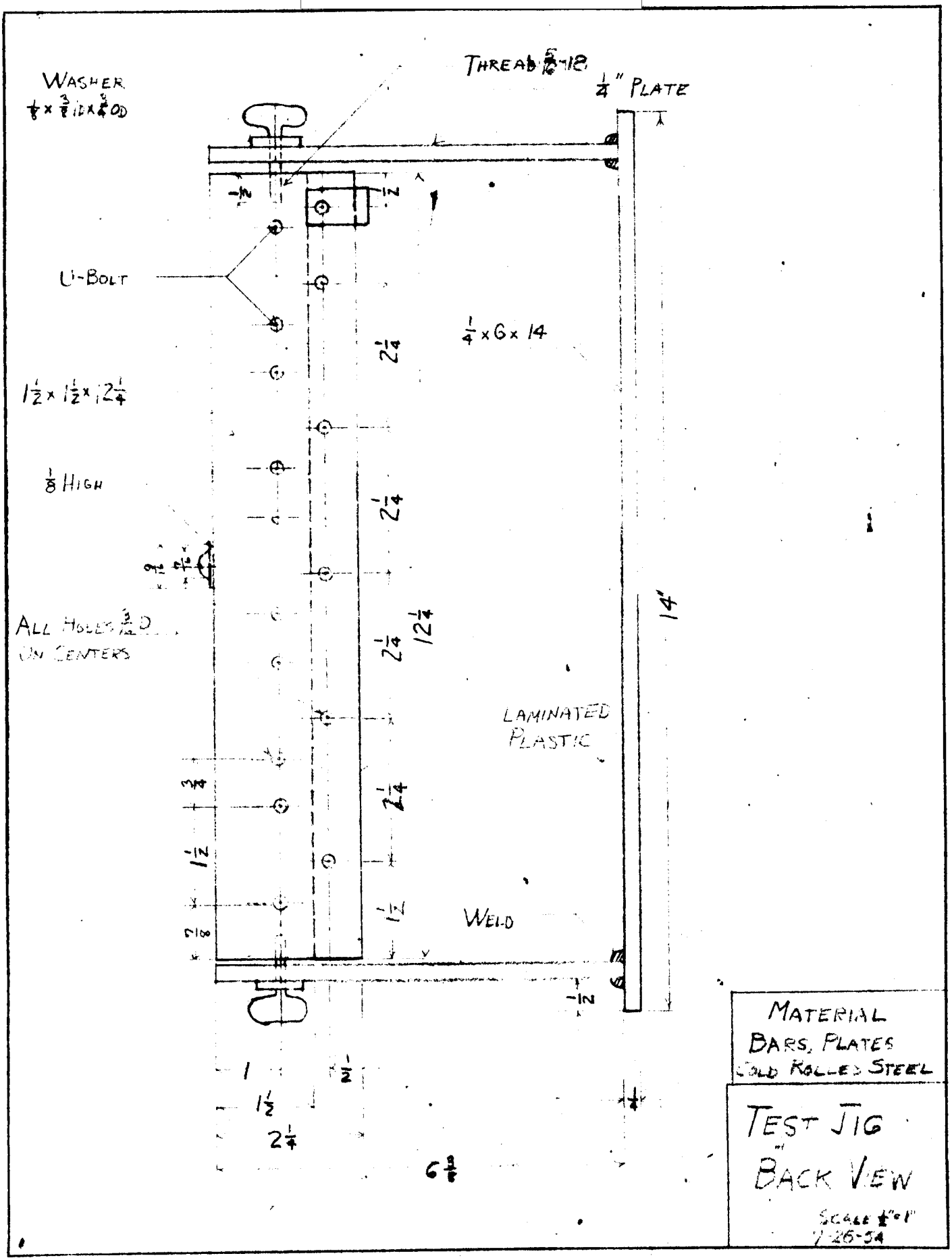


MATERIAL
AS NOTED ON DETAIL DRAWING

ADAPTER
ASSEMBLED

SCALE 2"-1"
7-28-54

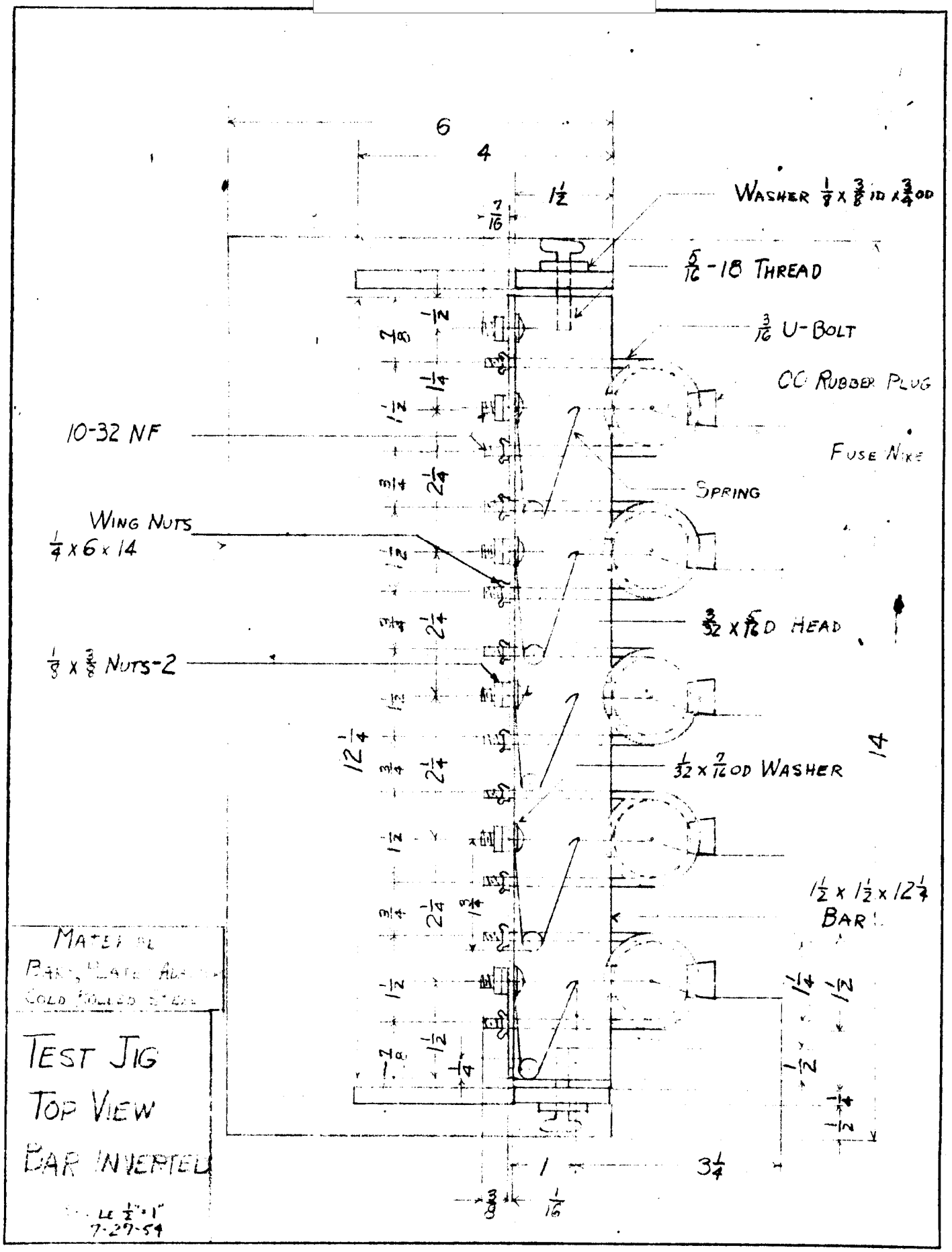
PREPARED
CHECKED
REF



25X1

PREPARED
CHECKED
REF

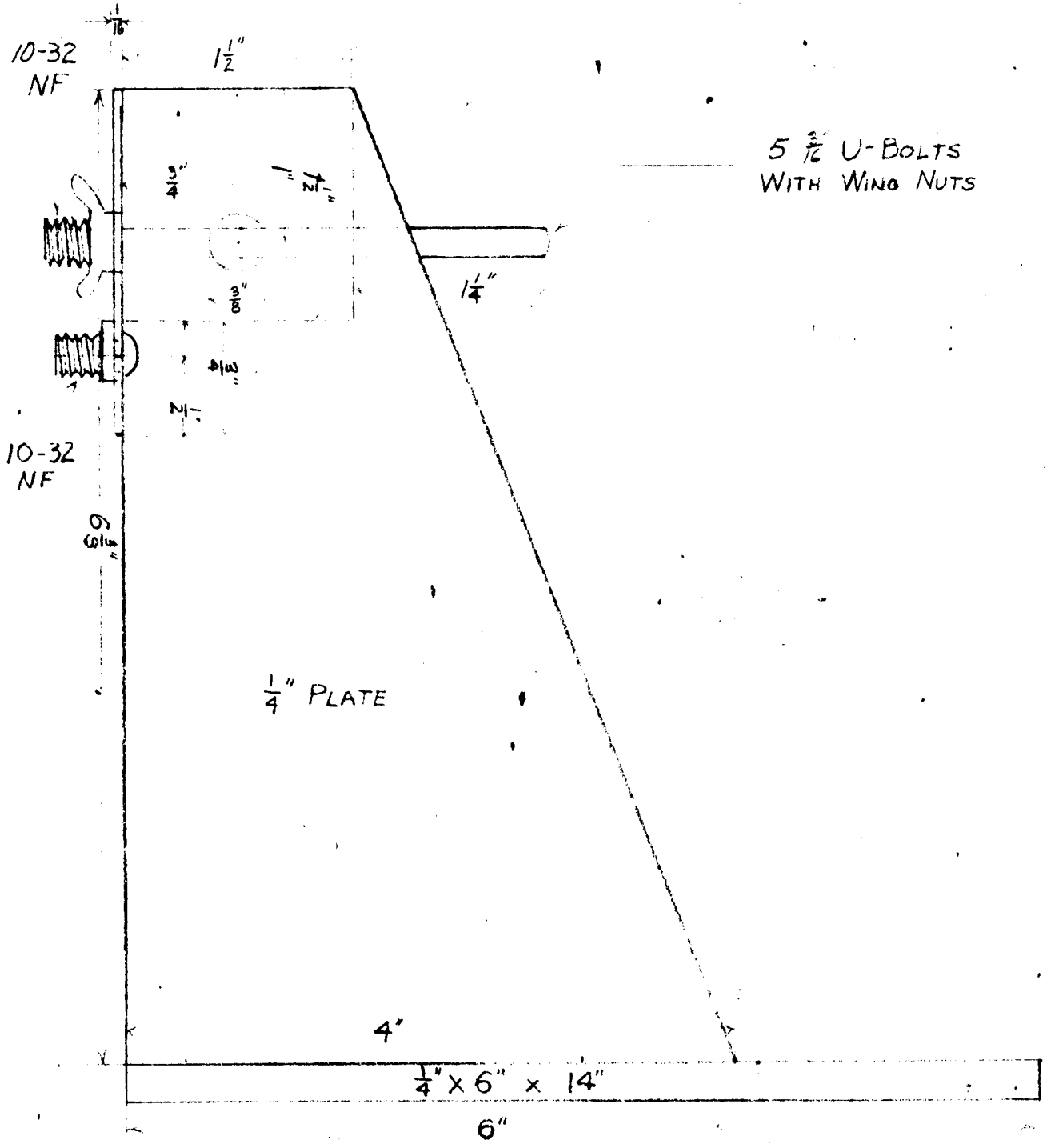
PAGE 31 REV.
REPORT
DATE



25X1

PREPARED
CHECKED
REF

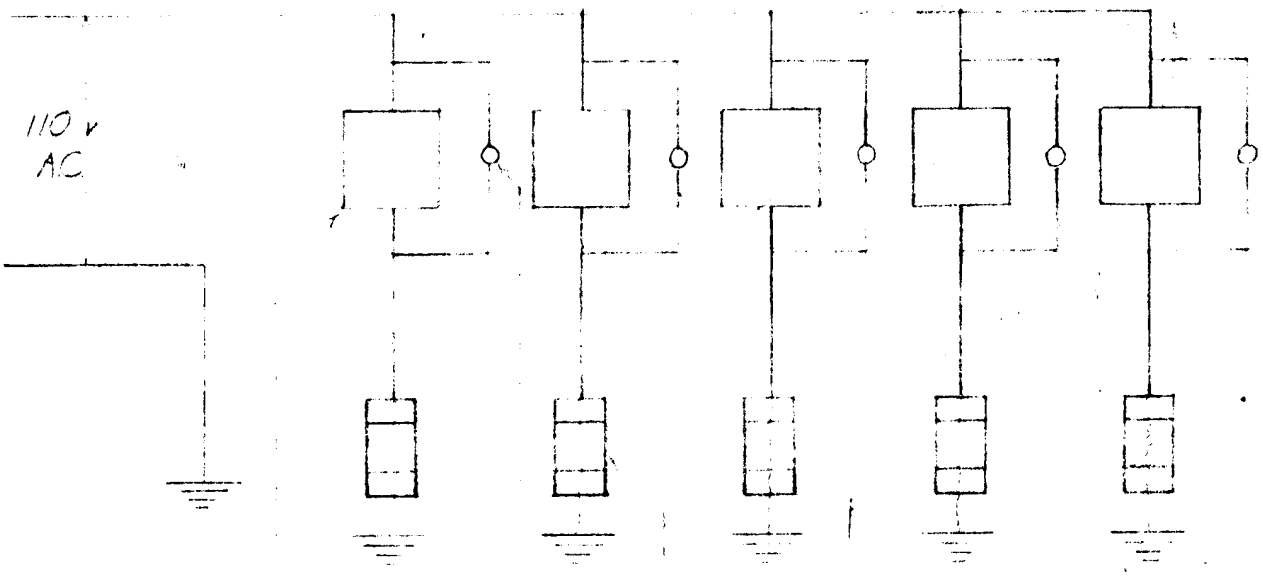
PAGE 32 REV.
REPORT
DATE



MATERIAL
BARS, PLATES
COLD ROLLED STEEL

SIDE VIEW
TEST JIG
SCALE 1"=1"
7-26-54

PREPARED
CHECKED
REF



ELECTRICAL
CIRCUIT
7-26-54

II Calibration of the Testing Jig:

Since the rebound of the weight is very small when it strikes the plate, the assumption that the collision is perfectly inelastic will not cause a great error in the calculation of the force of the impact. This error should not be greater than +3%. Furthermore, since the plate fits loosely into the cylinder and is lubricated and since the travel is very small the friction loss should not be more than -5%. Therefore, the error caused by the apparatus should not be more than +3% or -5%. The error caused by the reading of the diameter of the impression should not be more than ±5%.

Now, if we let F = the force, d = the distance that the force travels (the depth of the impression in the lead plate), m = the mass of the weight = 50.5 gr., h = the height from which the weight is dropped when v = o, v = velocity of the weight at the time of impact, t = time, g = the gravitational constant = 980cm/sec.^{2}, a = the acceleration, b = the radius of the impression, and r = the radius of the ball = 3/8 inch. Now since d is very small, the chord from the bottom of the impression to the top will be approximately equal to the arc. Then the following deviation is straightforward:

$$Fd = 1/2\ m\ v^2$$

Then: $$F = \frac{m\ v^2}{2d}$$

but: $$d = 1/2\ a\ t^2$$

and: $$v = g\ t$$

Consequently: $$F = \frac{m\ g\ h}{2d}$$

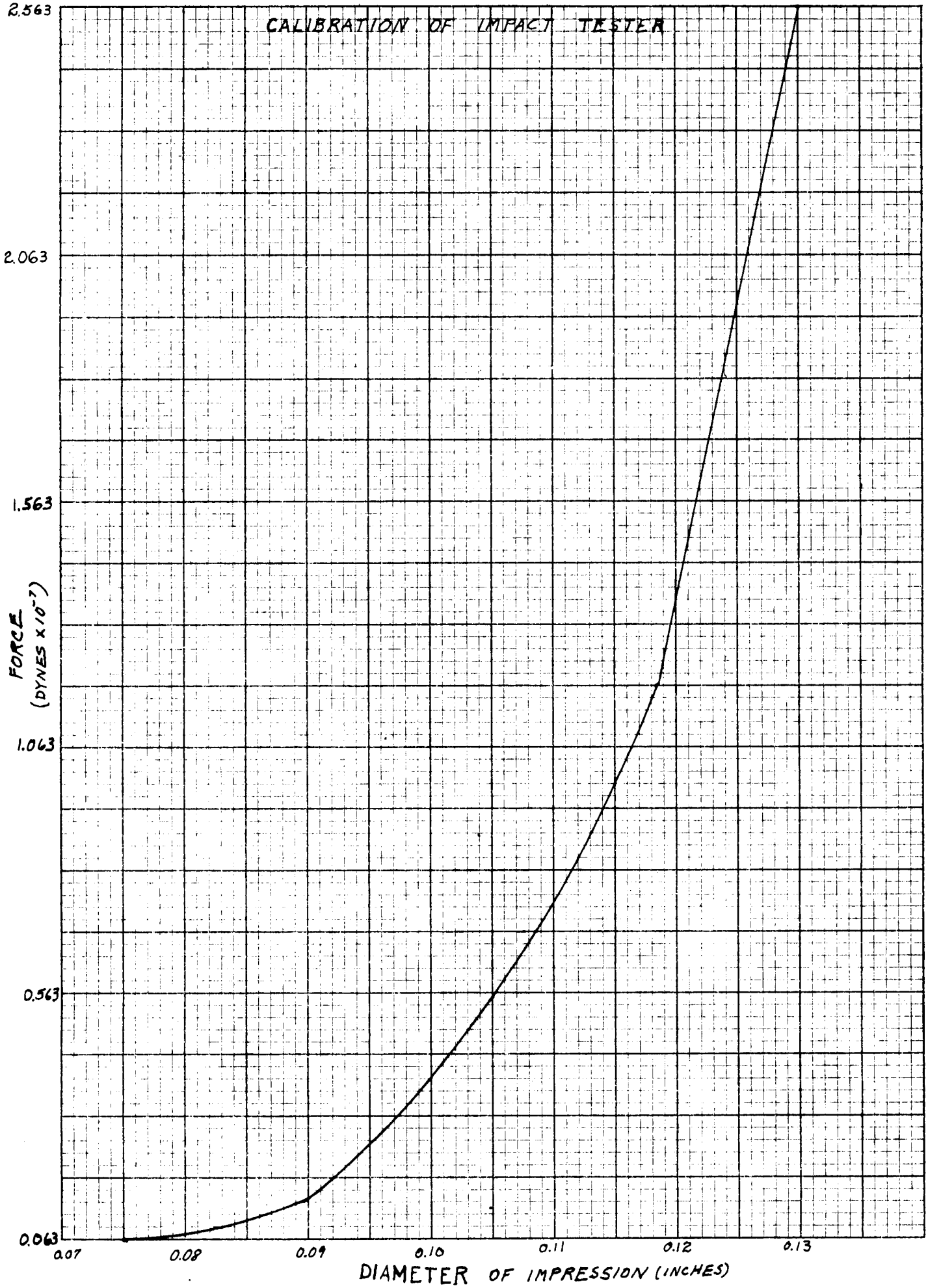
and by the substitution of numbers and by substitution of geometric identies,

$$F = \frac{50.5\ gr \times 980\ cm/sec.^2 \times h}{2\ (r - (r^2 = h^2)^{1/2})}$$

Using any consistent units for h, r and b, this formula will yield F in dynes (metric absolute CGS).

The jig was also calibrated using 1/2 inch balls, but although there was a slight increase of the sensitivity in the desired range, the loss of precision made the use of 1/2 inch balls impractical.

The following calibration curve was then drawn with r = 3/8.



III Derivation of Relationship Between Time Delay and the Thickness of the Plastic Disk;

The rate of diffusion of the solvent through the solvated plastic, obviously varies directly with the thickness of the solvated plastic. Therefore, if we let a represent the time it takes for the solvent to attack the plastic, $k_1 b$ represent the time it takes for the solvent to attack the solvated plastic, c represent the unsolvated plastic which is sheared when the striker pin ruptures the disk and $k_2 e$ represent the time taken by the attack of the solvated plastic upon the unsolvated plastic and the thickness of plastic causing an infinitesimal time delay by $k_3 D$, then the equation for an infinitesimal time delay dT is:

$$\frac{dT}{dD} = a + k_1 b_2 + c + k_2 e + k_3 D$$

Integration and removal of small terms then yields to a good approximation, $T = kD^2$.

IV AC Delay Firing Times:

RED AMPOULE

	113° F	104° F	95°F
	1.5 hrs.	1.6 hrs.	1.7 hrs.
	1.8	1.8	1.8
	2.4	2.1	1.9
	2.6	2.6	1.9
	2.6	3.1	2.1
	2.8	3.2	2.4
	2.9	3.3	2.5
	3.0	3.6	3.2
	-	3.7	3.3
	-	-	3.3
Mean	2.4 hrs.	2.8 hrs.	2.4 hrs.
Median	2.6 hrs.	3.1 hrs.	2.2 hrs.
Standard Deviation	0.577 hrs.	0.7 hrs.	0.6 hrs.
Coefficient of Variation	23%	28%	25%

	77°F	59°F	41°F
	1.4 hrs.	2.7 hrs.	7.3 hrs.
	1.7	4.9	7.7
	1.8	5.2	8.3
	1.8	5.6	8.8
	2.2	5.8	8.8
	2.6	6.1	8.8
	3.7	6.1	9.0
	3.7	6.2	9.1
	4.3	-	9.9
	4.4	-	-
Mean	2.8 hrs.	5.3 hrs.	8.6 hrs.
Median	2.4 hrs.	5.7 hrs.	8.8 hrs.
Standard Deviation	1.4 hrs.	1.5 hrs.	0.8 hrs.
Coefficient of Variation	50%	24.5%	9.3%

ORANGE AMPOULE

113°F	104°F	95°F
4.8 hrs.	5.2 hrs.	1.8 hrs.
4.9	5.4	2.1
4.9	5.6	2.6
5.0	5.6	3.1
5.1	5.7	5.0
5.1	5.7	5.1
5.3	5.9	5.7
5.3	6.0	5.8
-	6.1	6.1
-	6.4	-

Mean	5.1 hrs.	5.7 hrs.	4.1 hrs.
Median	5.0 hrs.	5.7 hrs.	5.0 hrs.
Standard Deviation	0.18 hrs.	0.35 hrs.	1.7 hrs.
Coefficient of Variation	3.5%	6.1%	41.5%

77°F	59° F	41° F
2.4 hrs.	10.2 hrs.	17.1 hrs.
6.7	10.6	19.8
6.9	10.9	22.3
7.1	11.0	25.8
7.1	11.2	25.8
7.4	11.2	27.0
8.2	12.0	27.1
-	12.2	33.6
-	12.8	39.0
6.5 hrs.	11.3 hrs.	26.4 hrs.
7.1 hrs.	11.2 hrs.	26.8 hrs.
1.9 hrs.	0.8 hrs.	6.7 hrs.
29.2%	7.3%	25.4%

YELLOW AMPOULE

113° F	104° F	95° F
3.1 hrs.	6.0 hrs.	9.6 hrs.
5.0	8.3	10.5
5.0	8.3	10.9
7.0	8.7	11.0
7.7	8.7	11.3
7.8	8.8	12.2
7.8	8.9	12.4
8.1	9.1	12.5
8.3	9.6	-
-	9.6	-
6.7 hrs.	8.6 hrs.	11.3 hrs.
7.7 hrs.	8.8 hrs.	11.2 hrs.
1.8 hrs.	1.1 hrs.	1.0 hrs.
27.5%	12.2%	9.1%

77° F	59° F	41° F
13.7 hrs.	19.3 hrs.	26.9 hrs.
14.7	19.8	37.8
14.8	20.0	42.3
14.8	20.0	43.9
14.9	20.5	48.0
15.0	21.3	53.2
15.7	21.3	56.6
15.9	22.2	58.1
-	24.5	64.6
-	25.1	79.7

Mean	14.9 hrs.	21.4 hrs.	51.1 hrs.
Median	14.8 hrs.	20.9 hrs.	50.6 hrs.
Standard Deviation	0.7 hrs.	2.0 hrs.	14.9 hrs.
Coefficient of Variation	4.5%	9.8%	29.2%

GREEN AMPOULE

113°F	104°F	95° F
9.6 hrs.	11.7 hrs.	15.3 hrs.
9.7	12.0	15.8
9.8	12.0	15.8
9.8	12.2	16.1
10.0	12.4	16.5
10.5	12.6	17.1
10.6	12.6	18.6
10.7	13.0	-
10.8	-	-
Mean 10.2 hrs.	12.3 hrs.	16.5 hrs.
Median 10.0 hrs.	12.3 hrs.	16.1 hrs.
Standard Deviation 0.5 hrs.	0.4 hrs.	1.1 hrs.
Coefficient of Variation 4.8%	3.1%	6.7%

77° F	59° F	41°F
15.2 hrs.	24.7 hrs.	81.0 hrs.
15.2	24.8	86.4
17.1	32.8	99.9
20.7	34.1	121.6
21.1	43.3	128.6
21.8	45.9	128.9
22.3	49.7	135.3
22.4	52.7	135.3
23.2	55.8	169.0
25.9	56.9	197.8
Mean 20.5 hrs.	42.1 hrs.	128.4 hrs.
Median 21.4 hrs.	44.6 hrs.	128.8 hrs.
Standard Deviation 3.55 hrs.	12.2 hrs.	35.6 hrs.
Coefficient of Variation 17.3%	29.0%	27.7%

BLUE AMPOULE

113°F	104°F	95° F
14.2 hrs.	18.8 hrs.	22.6 hrs.
15.0	21.9	22.7
15.3	22.4	23.8
15.7	22.5	24.8
15.8	22.8	26.1
17.2	22.8	26.4
17.5	22.9	29.2
19.2	-	34.0

Mean	16.2 hrs.	22.0 hrs.	26.2 hrs.
Median	15.8 hrs.	22.5 hrs.	25.5 hrs.
Standard Deviation	1.7 hrs.	1.5 hrs.	3.8 hrs.
Coefficient of Variation	10.5%	6.6%	14.5%

			41°F	
	77° F	59°F	No Luting	W/Luting
	17.7 hrs.	111.4 hrs.	618.6 hrs.	657.3 hrs.
	42.5 hrs.	119.0	711.1	829.3
	55.3	148.5	724.1	983.8
	55.4	170.8	1000.6	1205.2
	56.8	226.5	-	1220.9
	64.7	-	-	-
	67.4	-	-	-
	76.1	-	-	-
	82.3	-	-	-
Mean	57.6 hrs.	155.2 hrs.	763.6(Avg.)	979.3(Avg.)
Median	56.8 hrs.	148.5 hrs.	717.6 hrs.	983.8 hrs.
Standard Deviation	1.7 hrs.	46.4 hrs.	164.5 hrs.	246 hrs.
Coefficient of Variation	33.9%	29.8%	21.6%	25.1%

VIOLET AMPOULE

	113°F	104°F	95° F
	30.2 hrs.	44.7 hrs.	52.8 hrs.
	33.1	44.7	54.8
	34.1	44.7	56.9
	34.4	45.2	57.8
	34.8	45.4	61.1
	35.6	45.5	62.2
	35.7	47.7	63.0
	36.5	49.3	63.8
	37.3	-	-
Mean	34.6 hrs.	45.9 hrs.	59.0 hrs.
Median	34.8 hrs.	45.3 hrs.	59.4 hrs.
Standard Deviation	2.1 hrs.	1.7 hrs.	3.0 hrs.
Coefficient of Variation	6.1%	3.7%	5.1%

77°F	59° F	41°F
89.2 hrs.	75.9 hrs.	359.7 hrs.
95.0	140.0	372.1
99.2	161.4	377.4
100.6	165.0	378.9
105.7	166.1	389.3
106.6	166.1	429.8
108.5	168.1	448.8
113.7	168.2	451.2
-	196.3	524.5
-	204.0	562.9

Mean	102.3 hrs.	161.1 hrs.	429.5 hrs.
Median	103.2 hrs.	166.1 hrs.	409.1 hrs.
Standard Deviation	7.9 hrs.	34.9 hrs.	68.8 hrs.
Coefficient of Variation	7.8%	21.6%	16.0%

BLACK AMPOULE

	97°F	77°F	41° F
	7.38 days	17.50 days	10 units to fire elapsed time - 35 days
	8.23	19.13	
	8.40	28.26	
	8.40	28.45	
	8.40	29.83	
	9.58	29.86	
	9.70	34.02	
	13.00	34.89	
	13.08	38.44	
	13.67	-	
Mean	9.98 days	28.93 days	
Median	8.99 days	29.83 days	
Standard Deviation	2.35 days	6.90 days	
Coefficient of Variation	23.5%	23.8%	

WHITE AMPOULE

	97° F	77°F	41° F
	18.72 days	29.83 days	10 units to fire elapsed time - 105.5 days
	19.12	35.67	
	21.18	36.17	
	21.99	51.51	
	50.49	56.48	
	51.22	57.21	
	65.68	58.17	
	66.83	-	
	71.86	3 to fire@	
	105.11	90.0 days	
Mean	49.22 days	46.43 days	
Median	50.85 days	51.51 days	
Standard Deviation	29.35 days	12.1 days	
Coefficient of Variation	59.5%	26.2%	

CLEAR AMPOULE

97°F	77°F	41° F
9.83 days	44.98 days	1245.1 hrs.
10.84	45.00	1387.0
14.08	45.52	3127.0
14.94	47.18	-
19.56	48.76	7 to fire elapsed time - 136.8 days
20.10	50.66	
20.89	-	
22.40	-	
22.42	-	-
30.62	-	-

Mean	18.57 days	47.0 days	1919.7 hrs.
Median	19.83 days	46.35 days	1387 hrs.
Standard Deviation	8.8 days	2.33 days	1048 hrs.
Coefficient of Variation	47.5%	4.95%	54.6%

GOLD AMPOULE

97°F	77°F	41°F
37.25 days	44.96 days	10 to fire
38.75	46.08	elapsed
40.52	48.04	time -
40.92	50.04	134.7 days
41.31	61.44	
44.51	61.86	
45.85	65.93	
53.43	70.11	
65.21	84.30	
-	90.00	
Mean 45.3 days	61.65 days	
Median 41.31 days	61.98 days	
Standard Deviation 8.9 days	15.8 days	
Coefficient of Variation 19.6%	25.6%	

V & VI Tentative Manufacturing, Inspection and Packaging Specifications for Mark II Delay Firing Device Pack:

Specification No. T-266

7 March 1955

1. Purpose:

The purpose of this specification is to insure that the firing device pack is properly manufactured and assembled and that it will operate in the desired manner.

2. Markings:

No part of the Mark II Delay firing device pack, nor any component of the packaging or packing shall carry any trademarks, names, specification numbers or any other means of identification. Attention is called to the fact that if any of the specifications herein require symbols or marks on materials, these symbols or marks must be eliminated.

3. Parts:

The Mark II Delay firing device pack, shall consist of the following parts and assemblies described in the drawings and specifications listed below:

	Dwg. or Spec. No.
3.1 Body	T-266-400
3.2 Cap	T-266-401
3.3 Screw disk	T-266-402
3.3.1 Screw disk (training)	T-266-403
3.4 Striker pin	T-266-404
3.5 Retainer	T-266-405
3.5.1 Retainer (training)	T-266-406
3.6 Striker body	T-266-407
3.7 Striker spring	T-266-408
3.8 Firing device body assembly	T-266-200
3.9 Safety clip	T-266-409
3.10 Washer, large	T-266-410
3.11 Washer, small	T-266-411
3.12 Firing Device delay assembly	T-266-100
3.13 Capsule Seal	T-266-412
3.14 Capsule body	T-266-413

	Dwg. or Spec. No.
3.15 Capsule "O"-ring	T-266-414
3.16 Capsule body assembly	T-266-300
3.17 Capsule	T-266-201
3.18 Wrench	T-266-415
3.19 Lining, packaging	MIL-B-131B,Class 1
3.20 Tape, resealing	JAN-P-127-II-B
3.21 Can	T-266-416
3.22 Package cushioning	UU-C-843,Type II,Class B
3.23 Firing device delay package	T-266-500
3.24 Firing device package	T-266-501

4. Materials:

4.1 The body (Dwg. No. T-266-400) shall be of Zamac #5 grade zinc or its equivalent or of magnesium alloy Federal Spec. QQ-M-38. All external threads must be free turning and capable of manipulation by the operator's fingers throughout the entire length of the thread.

[redacted] 25X1

4.3 The screw disk (Dwg. No. T-266-402 or Dwg. No. T-266-403) shall be colloid of nitrocellulose and camphor containing no ingredients other than those specified. The nitrocellulose shall be thoroughly stabilized and the camphor shall be of the best commercial quality.

4.3.1 The composition of the colloid shall comply with the following limits:

Dry nitrocotton	71.0% ± 0.2%
Camphor	26.0% ± 0.2%
Triacetin	3.0% ± 0.1%
	100.0%

4.3.2 The nitrocotton used shall be from a single nitration batch or from a composite of two or more batches which do not vary from each other by more than 0.1% in nitrogen content and shall comply with the following limits:

Nitrogen content	11.0% + 0.1%
Viscosity	40 to 60 seconds

4.3.3 The colloid shall meet the following quality specifications:

Volatile material	1.6% max.
Sulfur compounds(as H_2SO_4)	0.15% max.
Acidity	neutral
Mineral ash	0.5% max.

4.3.4 The colloid shall be given a minimum of a 60 day cure under normal curing conditions for such material.

4.3.5 The colloid shall be extruded in the form of rods of a diameter of 1/2". They must be practically free from visible foreign matter and from mechanical imperfections.

4.3.6 At no time during the manufacture, assembly or inspection should the plastic or finished disks come in contact with oils, greases, soaps, resins, or soluble lubricating or cutting oils.

25X1

4.5 The retainer and/or the retainer (training) (Dwg. No. T-266-405 or Dwg. No. T-266-406) shall be machined from Screw Steel rod, Federal Spec. QQ-S-633, #FS1117, and shall be given a chrome plate according to MIL-P-6871, Type I, Class A.

4.6 The striker body (Dwg. No. T-266-407) shall be machined from Screw Steel rod, Federal Spec. QQ-S-633, #FS1117, and shall be given the chrome plate according to MIL-P-6871, Type I, Class A.

4.7 The striker spring (Dwg. No. T-266-408) shall be made from music wire and shall be shot-peened, stress relieved and cadmium plated.

4.8 The safety clip (Dwg. No. T-266-409) shall be made from steel strap metal (Federal Spec. QQ-S-781a(3).

4.9 The washer, large (Dwg. No. T-266-410) shall be made from Precision Rubber Company's Thiokol Grade 1000-70 or its equivalent.

4.10 The washer, small (Dwg. No. T-266-411) shall be made from Precision Rubber Company's Thiokol Grade 1000-70 or its equivalent.

4.11 The capsule seal (Dwg. No. T-266-414) shall be made of lead. Both pure lead and buckshot have been found acceptable.

4.12 The capsule body (Dwg. No. T-266-413) shall be made of brass.

4.13 The capsule "O"-ring (Dwg. No. T-266-412) shall be made from Thiokol, Precision Rubber Company's Grade No. 1000-70 or its equivalent.

4.14 The solvents used in making up the solutions shall be the following:

4.14.1 [redacted] 25X1

4.14.2

4.14.3

4.14.4

4.14.5

142-0.

4.14.6 Dimethyl phthalate shall meet requirements of JAN-D-709.

4.14.7 Ethyl lactate shall be Fisher's Highest Purity grade or its equivalent and shall be redistilled using a column which is capable of maintaining a 1°C differential, collecting the fraction boiling at 150-152°C.

4.14.8 n-Butyl lactate shall be Fisher's Highest Purity grade or its equivalent and shall be redistilled using a column which is capable of maintaining a 1°C differential, collecting the fraction boiling at 70-81°C at 12 mm Hg.

4.15 The wrench (Dwg. No. T-266-414) shall be made from 1020 carbon, cold rolled, sheet steel, Federal Spec. QQ-S-636.

4.16 The lining, packaging shall be MIL-B-131B, Class I.

4.17 The tape, resealing, shall be made according to JAN-P-127, Type 2, Grade B, Color O.D., and shall be a minimum of 26 inches long and shall be 1/2 inch wide.

4.18 The can (Dwg. No. T-266-500) shall be made according to acceptable commercial standards.

4.19 The packaging cushioning shall be made according to UU-C-843, Type II, Class B.

5. Finish:

5.1 The finish for the body and cap shall be as follows:

5.1.1 The finish for the body and cap (Dwg. Nos. T-266-400 and T-266-401) of the service unit shall be blue-grey, lusterless quick-drying enamel (MIL-E-10687A, No. 331). Care should be taken to insure that the internal threads of the body are not clogged with paint and that the external threads of the body on the firing pin end are not painted.

5.1.2 Both the exterior and interior of the body and the cap, with the exception of the internal threads of the body on the firing pin end, of

the training unit (Dwg. Nos. T-266-400 and T-266-401) shall be painted with MIL-E-10687A, No. 3530. A 1/4" wide stripe shall be painted around the unfluted section of the cap using a radioactive type phosphorescent paint having a phosphorescent glow approximating TT-C-595 No. 3530 and having a certified life of not less than eight years. A yellow letter "T" at least three-quarters of an inch high shall also be painted on the end of the cap.

5.2 The striker body, striker screw and retainer shall be chrome plated according to Spec. MIL-P-6871, Type I.

5.3 The capsule body assembly shall be painted as shown in Dwg. No. T-266-300 with lacquer, Federal Spec. TT-L-58. The color of this lacquer shall be one of the following:

Federal Spec. TT-C-595, red No. 1110, yellow, No. 1320, green, No. 1460, blue, No. 1525, brown, No. 1020, black, No. 1775, silver, No. 1760, grey, No. 1630.

5.4 The safety clip shall be painted on both sides with MIL-E-10687A, No. 3725.

5.5 The can (Dwg. No. T-266-416) shall be given a coat of MIL-E-10687A, No. 331.

6. Dimensions:

All dimensions shall be in accordance with Drawings listed in Section 3. above.

7. Assembly:

The parts shall be assembled in accordance with Dwg. Nos. T-266-300, T-266-200, T-266-201, T-266-100 and T-266-501.

7.1 The screw disk (Dwg. No. T-266-402 or Dwg. No. T-266-403) is held in place on the body by screwing the retainer (Dwg. No. T-266-405 or Dwg. No. T-266-406) firmly in place. The striker pin (Dwg. No. T-266-404) is inserted into the screw disk. The striker body and spring are then screwed onto the striker pin and tightened to a pressure of 8 foot pounds ± 1 foot pound, holding the head of the striker screw in a jig to prevent it from turning.

7.2 The "O"-ring, large (Dwg. No. T-266-410) and the washer, (Dwg. No. T-266-411) are slipped into place on the body assembly (Dwg. No. T-266-200)

7.3 The safety clip (Dwg. No. T-266-409) shall be snapped into place upon the body assembly (Dwg. No. T-266-200). It must be tight enough so that it does not rattle.

7.4 The cap (Dwg. No. T-266-401) shall be screwed onto the body assembly (Dwg. No. T-266-200) finger tight.

7.5 The capsule will be filled without any void with the desired solvent and immediately sealed. Although any approved method would be acceptable, the following method has been used satisfactorily. A layer of solder has been placed upon the solid end of the capsule and a 0.025 inch diameter hole drilled through the solder and capsule end. The capsule is filled carefully using a No.27 hypodermic needle and immediately pounding the solder over the hole to seal the capsule.

7.6 The capsule body assembly (Dwg. No. T-266-300) will be painted in the manner shown in the drawing, using the paints shown below:

TT-C-595 Color	Filling	Dye
Red No. 1110	Acetone	Du Pont Fuchsine N
Yellow No. 1320	n-Propyl acetate	Du Pont Oil Orange & Du Pont Oil Red
Green No. 1460	n-Butyl acetate	Du Pont Oil Yellow N
Blue No. 1525	97% ± 0.3% iso-amyl acetate 3% ± 0.1% ethyl acetate ethyl lactate	Du Pont Anthraquinone Green G Base & Du Pont Oil Yellow N
Brown No. 1020	Ethyl lactate	Du Pont Oil Blue A
~~Black No. 1775~~	~~n-Butyl lactate~~	~~Du Pont methyl violet base~~
~~Silver~~ No. 16760	66.2% dimethyl phthalate, 37.8% butyl lactate	Du Pont Fuchsine N
~~Grey~~ No. 1630	83.4% ± 0.3% dimethyl phthalate, 16.6% ± 0.3% butyl lactate	Du Pont Anthraquinone ~~Green G Base~~
Gold No. 1765	99.0% ± 0.3% dimethyl phthalate, 1.0% ± 0.1% butyl lactate	Du Pont Oil Orange

The dye will be added to the solvent in amounts necessary for easy identification.

7.7 After the paint has thoroughly dried, the capsule "O"-ring (Dwg. No. T-266-415), which has been previously lubricated with petroleum jelly, shall be stretched into the "O"-ring groove on the capsule assembly.

7.8 The body assembly, one capsule of each type and one M-34 detonator shall be sealed in the liner as shown in Dwg. No. T-266-501.

7.9 The body assembly capsules and detonators, sealed in the liner, packaging, are placed in the can (Dwg. No. T-266-502). The can shall be completely filled with the packaging cushioning (UU-C-843-II-B) to prevent the contents from touching the can.

7.10 The wrench, tape, resealing and the instruction sheet shall be placed between the cotton and the can itself and the can shall be sealed.

8. Inspection:

8.1 2% of each production lot of not less than 1,000 nor more than 4,000 caps and bodies shall be tested as follows:

8.1.1 The external threads of the firing pin end of the body shall be checked with gauges.

8.1.2 The caps shall be screwed all the way down to insure ease of turning.

8.1.3 The diameter of the head of the striker pin shall be checked. Special attention will be paid to the knife edge of the under side of the head to insure its uniformity.

8.1.4 The retainer and the striker screw shall be checked for dimensions.

8.2 The screw disks shall be tested as follows: During these inspections, the screw disks shall be handled by the edges only, using clean gloves.

8.2.1 All screw disks shall be given a visual examination. The edges of the hole must be clean, straight and square cut. The material shall be free from visible foreign matter and from mechanical imperfections such as scratches and marks caused by hot drills.

8.2.2 At least 10% of the disks shall be tested, using "go and no-go" gauges, for external and internal diameters.

8.2.3 All screw disks shall be tested for thickness.

8.2.4 A ground composite sample from a minimum of 1% of the screw disks shall be analyzed for nitrogen content of the nitrocellulose, acidity, volatile material and mineral ash.

8.2.4.1 Five grams of coarsely ground material shall be exposed for 48 hours under vacuum over sulfuric acid. The loss in weight shall be considered the volatile content.

8.2.4.2 The surface acidity shall be determined. Two grams of freshly and finely ground material are added to a mixture of 10 ml distilled water and 0.5 ml of a 0.2% alcoholic solution of dimethylaminoazobenzine in a stoppered test tube. The mixture is thoroughly shaken and allowed to stand for three hours, with intermittent shaking. 0.1 grams of filter pulp is added and the tube shaken vigorously. The color shall be identical to the color of a standard solution made by shaking 0.1 gram of filter pulp with a solution of 5.0 ml of indicator solution, 6.1 ml of N/10 hydrochloric acid and 3.9 mls of a solution containing 21 grams cetric acid monohydrate and 200 mls N/1 sodium hydroxide solution per liter.

8.2.4.3 The nitrocellulose will be extracted in a soxhlet apparatus with chloroform for 20 hours. The extracted nitrocellulose is placed in a closed vessel through which steam is passed for 2 hours and then dried in a vacuum over sulfuric acid. The nitrogen content shall be determined by means of a nitrometer, according to ASTM procedure D-201-50.

8.2.4.4 The ash content shall be determined according to ASTM procedure D-301-50.

Next 2 Page(s) In Document Denied

8.5.1 The liners containing the body assembly, capsules and M-34 detonator shall be submerged in water at a temperature of 35-45°F for a minimum of 25 hours. At the end of that period the liner shall be removed, the outside dried thoroughly and the unit inspected for any signs of water leakage.

8.5.2 The contents of the can shall be inspected to insure that all components are present.

8.5.3 All of the capsules shall be put in the unarmed position inside the capsule body to insure that they are the right size. All parts except the liner may be returned to production supply stocks.

8.6 The manufacturer shall perform inspections 8.2.4, 8.2.5, 8.4.1, 8.2.2 and 8.2.4. All other inspections shall be done by the contracting authority.

9. Rejections:

9.1 If any of the units fail to comply with each of the sections of 8.1, 8.2.2, 8.2.4, 8.2.5, 8.3, 8.4.1 or 8.4.2, the entire lot submitted for tests at that time will be rejected. This will not prohibit the manufacturer from reworking them and resubmitting any or all of those previously rejected. If the units being tested are a retest, the inspector shall be so informed. In case of a retest, the inspector may, at his discretion, select twice the number of samples submitted to be tested in the first inspection.

9.2 If any sample fails to comply with Sections 8.2.1, 8.2.3, or 8.4.4 it shall be rejected.

10. Packaging and Packing Requirements:

10.1 The following specifications of the issues in effect on the date of invitation for bids and special requirements form a part of this specification for purchases made under this specification.

10.2 Specifications:

JAN-P-125(1) Packaging and packing for overseas shipment, barrier-materials, waterproof, flexible.

MIL-A-140A Adhesive; water resistant, waterproof barrier-material.

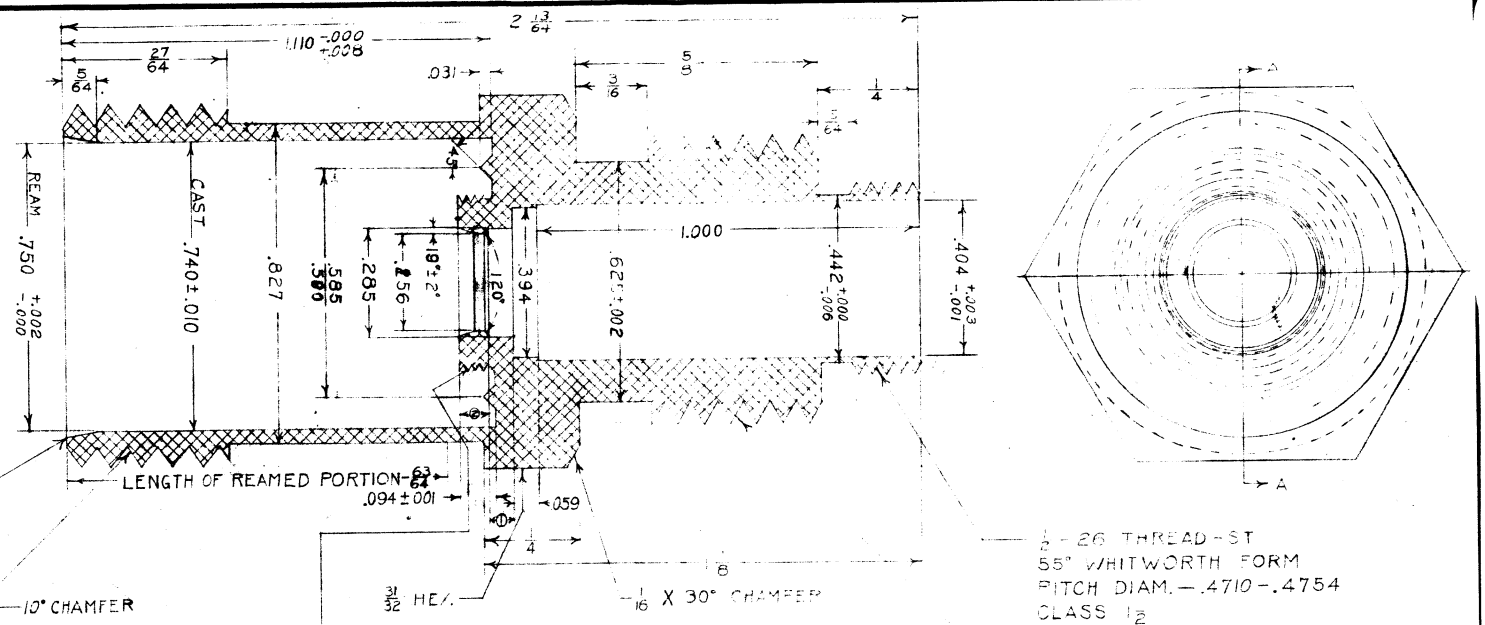
UU-P-31b Paper; general specifications and methods of testing.

QQ-S-781a(3) Strapping, flat, steel.

JAN-P-106A Packaging and Packing for overseas shipment.

10.3 Method of Packaging:

10.3.1 The liner bag (Ref. JAN-P-1251(1)) shall be placed inside a Style 4 box of group 1 or 2 wood (Ref. JAN-P-106A) and the delay firing device packs shall be placed in the liner in five layers, 5 packs long and 2 packs wide. A 0.040 inch thick separator (Ref. UU-P-31 (b)) shall be placed between the layers and two such separators shall be placed between the packs and the liner. The lid shall be nailed in place and two 5/8 inch wide metal straps (Ref. QQ-S-781a(3)) shall be placed around the case approximately 3 inches from each end.



INTERNATIONAL METRIC FINE
MAJOR DIAM. - 24.0 MM.
MINOR DIAM. - 21.18 MM.
PITCH - 2 MM.
FREE FIT

.4570 - 64 NS - 2
PITCH DIAM. - .4449 - .4469

SECTION A-A

3/4 - 12 B.S.F. THREAD - ST
55° WHITWORTH FORM
PITCH DIAM. - .6903 - .6959
CLASS 1 1/2
FREE FIT

1/2 - 26 THREAD - ST
55° WHITWORTH FORM
PITCH DIAM. - .4710 - .4754
CLASS 1 1/2
FREE FIT

PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
MATERIAL ZAMAC #5		FINISH MIL-E-10687A #331	
DRAWN BY M.L.C.		APPROVED BY	
DATE 12-4-54		SCALE 4"=1"	
NEXT ASSEMBLY		MODEL	

BODY

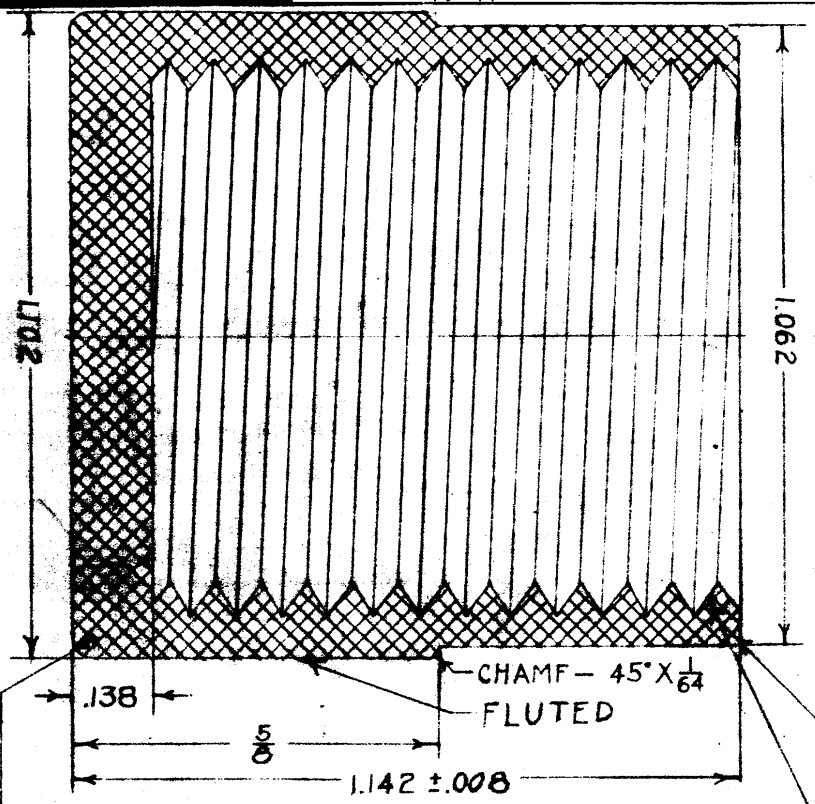
NOTE
Ⓓ .062
Ⓓ .078±.001

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 1/32 DECIMALS ± .005 ANGLES ± 5°

DWG SIZE	DWG NO	ISSUE
B	T-206-400	

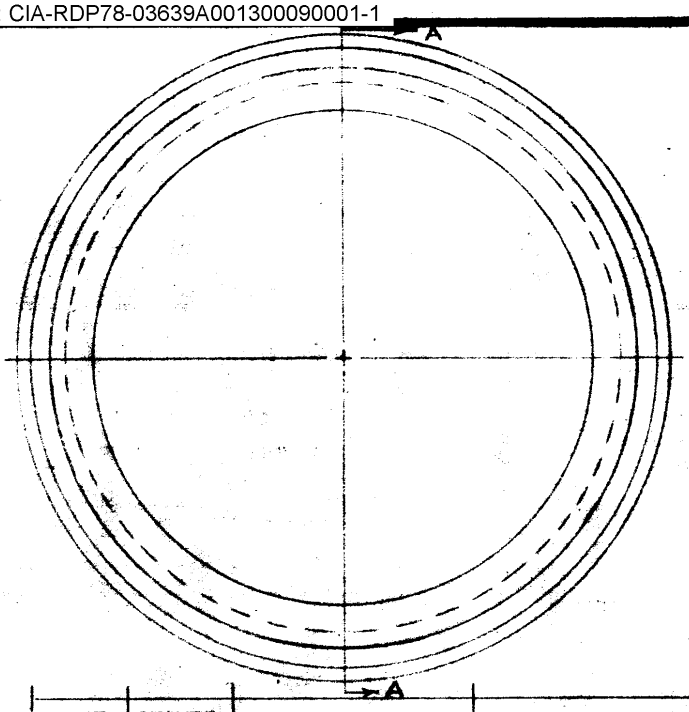
SHEET 1 OF 23 SHEETS



INTERNATIONAL METRIC FINE
MAJOR DIAM. - 24.22 MM.
MINOR DIAM. - 21.40 MM.
PITCH - 2 MM.
FREE FIT

CHAMF - 45° X 1/32

SECTION A-A



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL

MATERIAL - ZAMAC #5	FINISH MIL-E-10687 #331
DRAWN BY M.L.C[redacted]	APPROVED BY
DATE 11-13-54	SCALE 4" = 1"
NEXT ASSEMBLY	MODEL

CAP

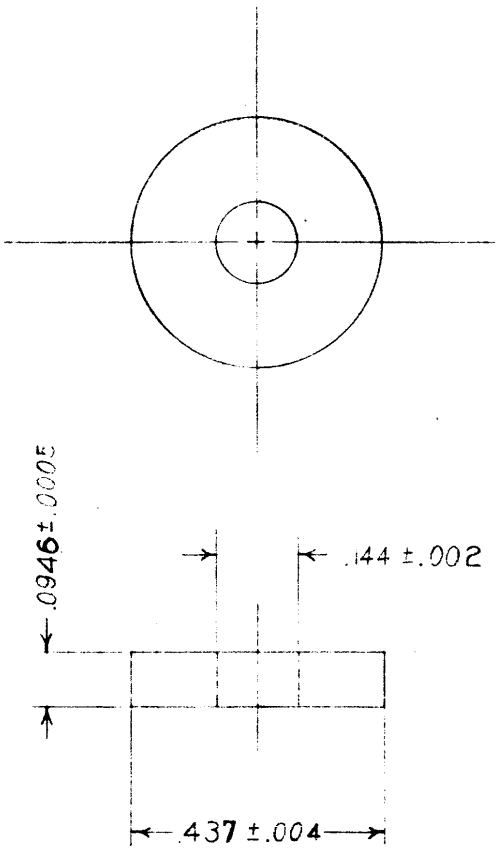
NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 5°

DWG SIZE	DWG NO	ISSUE
A	T-266-401	

SHEET 2 OF 23 SHEETS

NOTE
MATERIAL: NITROCELLULOSE – CAMPHOR
CONCENTRICITY -.003



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
MATERIAL SEE NOTE		FINISH NATURAL	
DRAWN BY M.L.C.		APPROVED BY	
DATE 12-28-54		SCALE 4"=1"	
NEXT ASSEMBLY		MODEL	

SCREW DISK

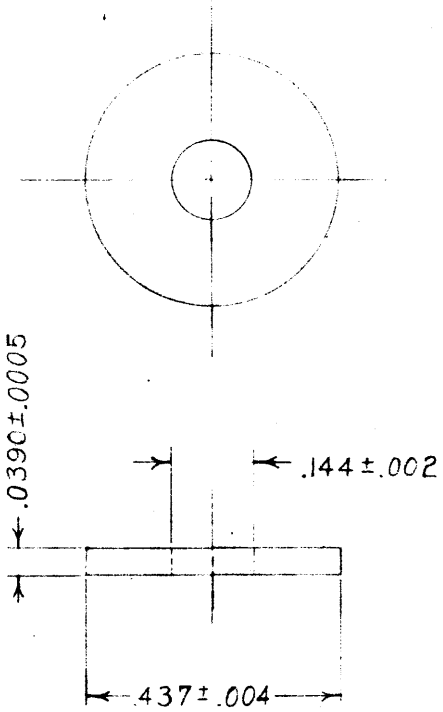
NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ± ANGLES ±

DWG SIZE	DWG NO	ISSUE
A	T-266-402	

SHEET 3 OF 23 SHEETS

NOTE
MATERIAL: NITROCELLULOSE -CAMPHOR
CONCENTRICITY-.003



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL

MATERIAL	SEE NOTE	FINISH	NATURAL
DRAWN BY	M. L. C[redacted]4	APPROVED BY	
DATE	12-28-54	SCALE	4"=1"
NEXT ASSEMBLY		MODEL	

SCREW DISK (TRAINING)

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ± ANGLES ±

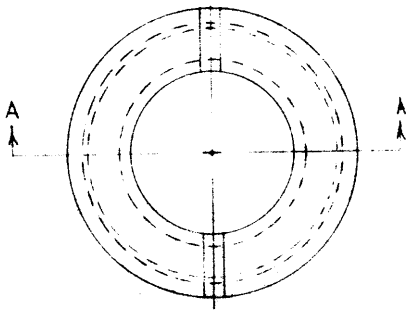
DWG SIZE	DWG NO	ISSUE
A	T-266-403	

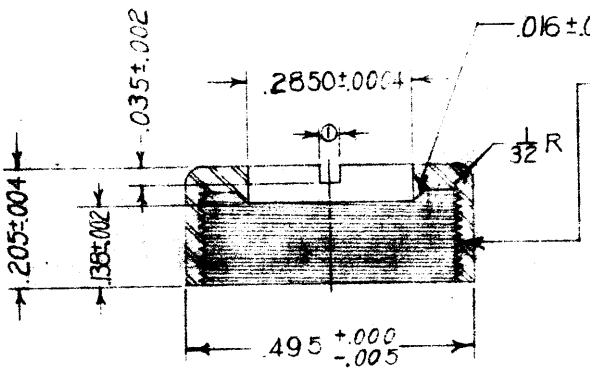
SHEET 4 OF 23 SHEETS

NOTES

Ø .030 ±.005

FINISH: MIL-P-6871
TYPE I, CLASS A
0.0002 MIN. THICKNESS
CHROMIUM PLATE





SECTION A-A

PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
MATERIAL FED SPEC QQ-S-633* FS 1117		FINISH SEE NOTE	
DRAWN BY M.L.C[redacted]		APPROVED BY	
DATE 12-18-54		SCALE 4"=1"	
NEXT ASSEMBLY		MODEL	

RETAINER

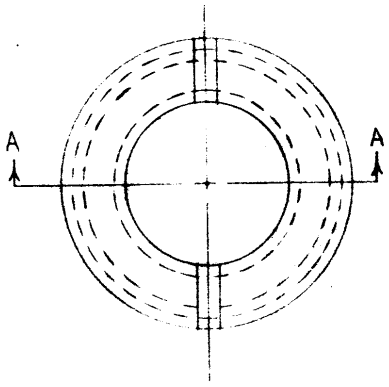
NO	DATE	REVISIONS	BY

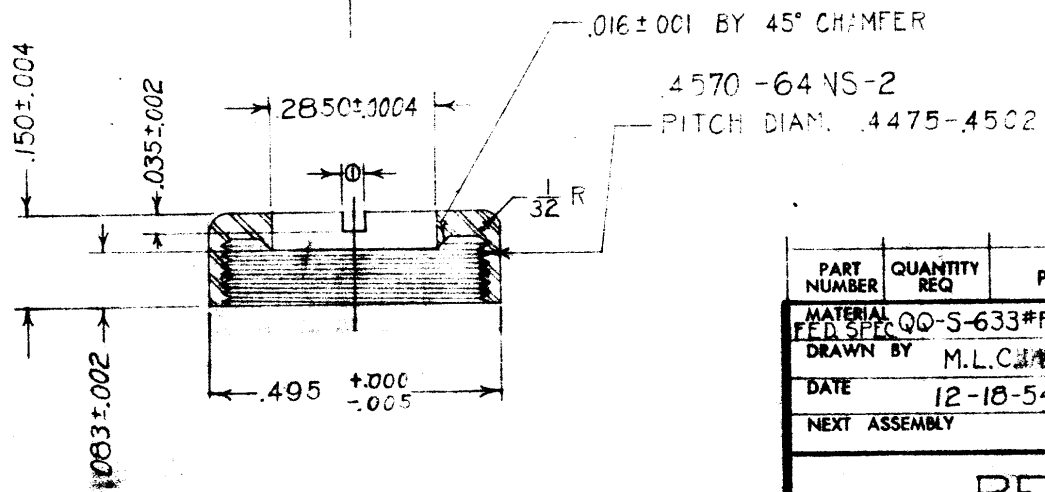
UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 1/64 DECIMALS ± ANGLES ± 5°

DWG SIZE	DWG NO	ISSUE
A	T-266-405	

SHEET 6 OF 23 SHEETS

NOTES
@ .030 ± .005
FINISH: MIL-P-6871
TYPE I, CLASS A
0.0002 MIN. THICKNESS
CHROMIUM PLATE





SECTION A-A

PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
MATERIAL FED SPEC QQ-S-633#FS 1117		FINISH SEE NOTE	
DRAWN BY M.L.C.		APPROVED BY	
DATE 12-18-54		SCALE 4"=1"	
NEXT ASSEMBLY		MODEL	

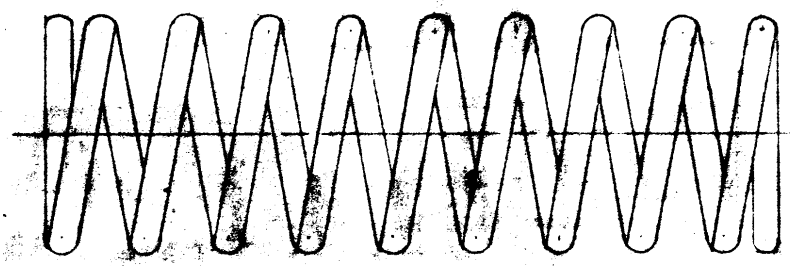
RETAINER (TRAINING)

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 1/64 DECIMALS ± ANGLES ± 5°

DWG SIZE	DWG NO	ISSUE
A	T-266-406	

SHEET 7 OF 23 SHEETS



SPECIFICATIONS

FREE LENGTH ——— $1\frac{1}{4} \pm \frac{1}{8}$
NO. OF COILS ——— 9 I.D. -.297 ± .005
WIRE DIA. ——— .042"
MUST BE LEFT-HAND WINDING
ENDS: CLOSED & GROUND
COMPRESS TO .450" UNDER LOAD OF 12 LB. ± $\frac{3}{8}$ LB.
SPRING MUST PASS OVER .295" DIA.
SPRING MUST BE FREE FROM TOOL & COILING MARKS
SPRING MUST BE SHOT-PEENED & STRESS RELIEVED
COMPRESS EACH SPRING COMPLETELY 3 TIMES BEFORE INSPECTION.

NO	DATE	REVISION	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ± .005 ANGLES ±

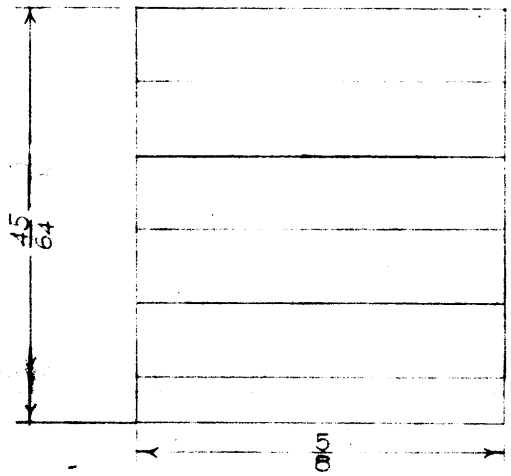
PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL

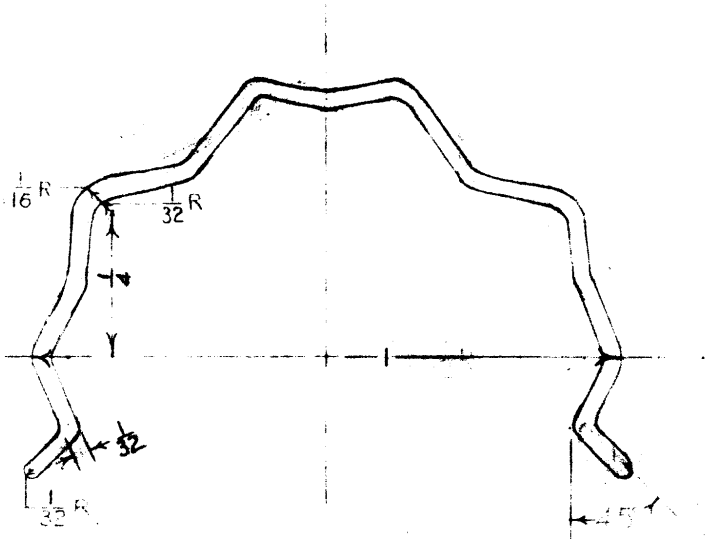
MATERIAL MUSIC WIRE	FINISH CADMIUM PLATE
DRAWN BY M.L. C[illegible]SON	APPROVED BY
DATE 1-27-55	SCALE 4" = 1"
NEXT ASSEMBLY	MODEL

STRIKER SPRING

DWG SIZE	DWG NO	ISSUE
A	T-266-408	

SHEET 9 OF 23 SHEETS





PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL

MATERIAL	QQ-S-781a(3)	FINISH	NATURAL
DRAWN BY	M.L.C.	APPROVED BY	
DATE	1-29-55	SCALE	4"=1"
NEXT ASSEMBLY		MODEL	

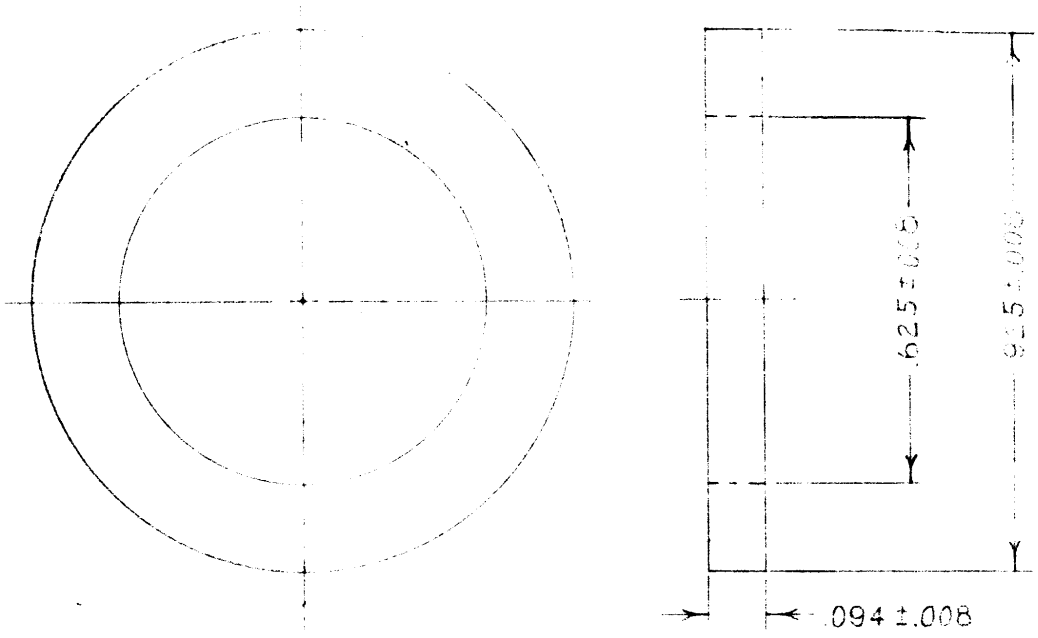
SAFETY CLIP

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 64 DECIMALS ± ANGLES ± °

DWG SIZE	DWG NO	ISSUE
A	T-266-409	

SHEET OF 2 SHEETS



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL

MATERIAL	SEE NOTE	FINISH	NATURAL
DRAWN BY	M.L. CRAZEN	APPROVED BY	
DATE	1-8-55	SCALE	4"=1"
NEXT ASSEMBLY		MODEL	

NOTE

MATERIAL: THIOKOL, PRECISION RUBBER COMPANY'S GRADE NO. 1000-70

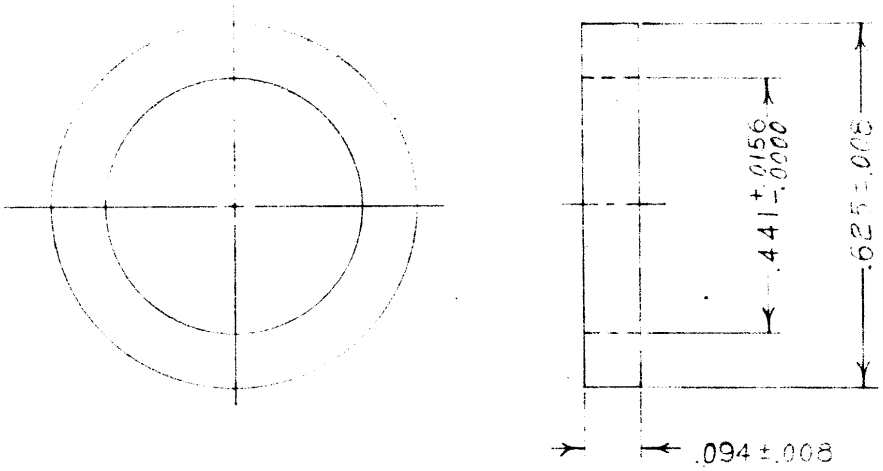
WASHER (LARGE)

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ± ANGLES ±

DWG SIZE	DWG NO	ISSUE
A	T-266-410	

SHEET 12 OF 23 SHEETS



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL

MATERIAL	SEE NOTE	FINISH	NATURAL
DRAWN BY	M.L.C.	APPROVED BY	
DATE	1-8-55	SCALE	4"=1"
NEXT ASSEMBLY		MODEL	

NOTE

MATERIAL: THIOKOL, PRECISION RUBBER COMPANY'S GRADE NO. 1000-70

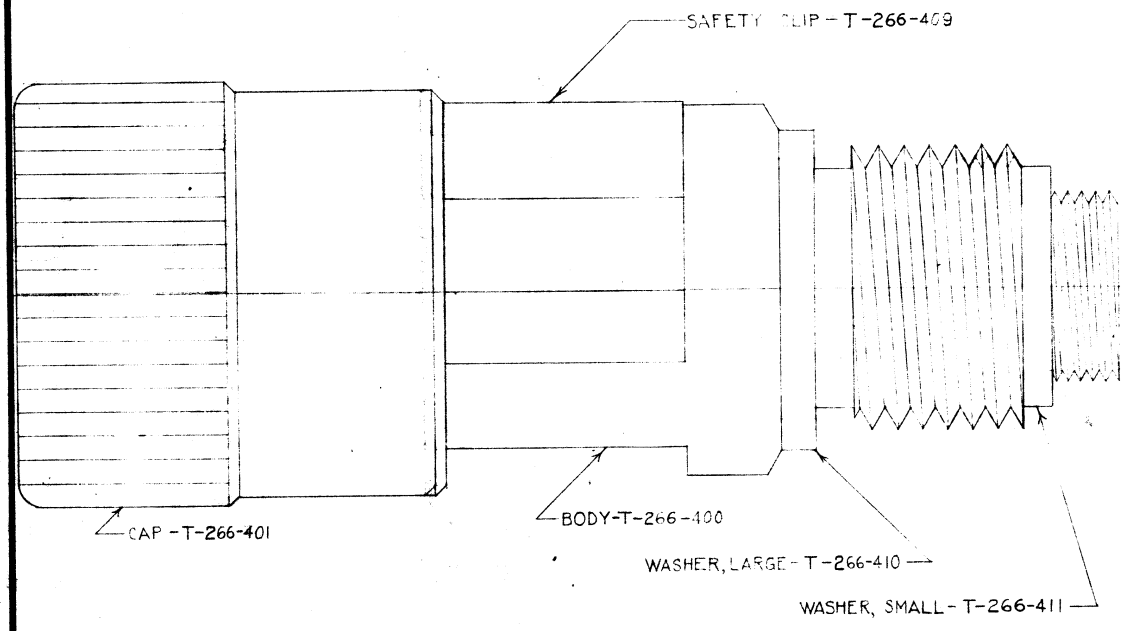
WASHER (SMALL)

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ± ANGLES ±

DWG SIZE	DWG NO	ISSUE
A	T-266-411	

SHEET 13 OF 23 SHEETS



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
400	1	BODY	ZAMAC #5
401	1	CAP	ZAMAC #5
409	1	SAFETY CLIP	QQ-S-781a(3)
410	1	WASHER, LARGER	*
411	1	WASHER, SMALL	*

MATERIAL | FINISH
DRAWN BY M.L.C. | APPROVED BY
DATE 1-7-55 | SCALE 4"=1"
NEXT ASSEMBLY | MODEL

25X1

DELAY ASSEMBLY

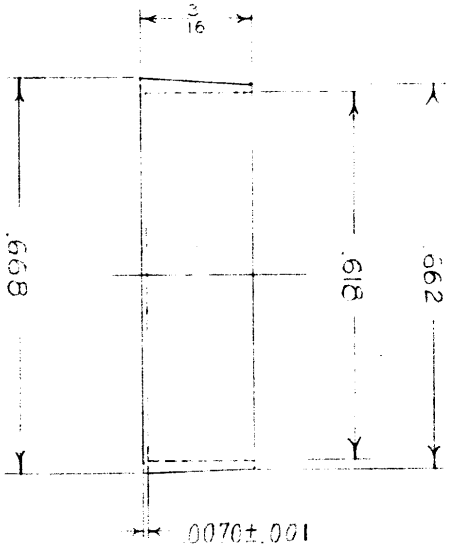
NOTE
* THIOKOL PRECISION RUBBER COMPANY'S GRADE NO. 1000-70

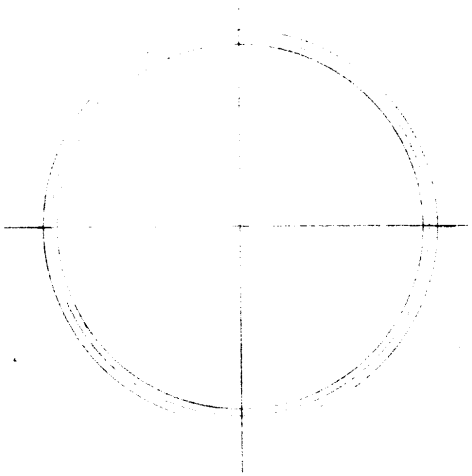
NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ± ANGLES ±

DWG SIZE B | DWG NO T-266-100 | ISSUE

SHEET 14 OF 23 SHEETS





PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL

MATERIAL LEAD	FINISH NATURAL
DRAWN BY M.L.C.	APPROVED BY
DATE 1-29-55	SCALE 4" = 1"
NEXT ASSEMBLY	MODEL

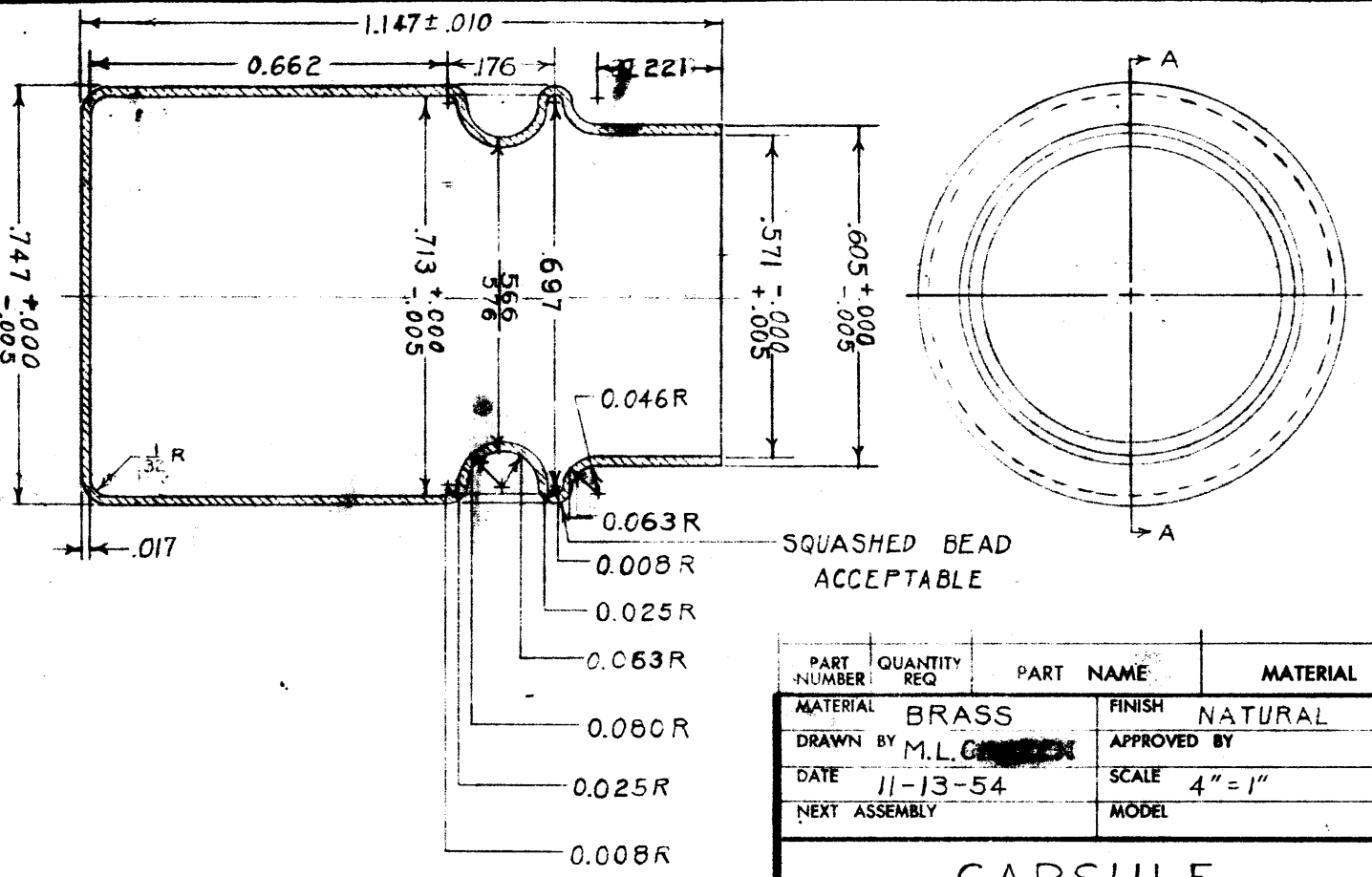
CAPSULE SEAL

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 1/32 DECIMALS ± .010 ANGLES ±

DWG SIZE	DWG NO	ISSUE
A	T-266-412	

SHEET 15 OF 23 SHEETS



SECTION A-A

PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL

MATERIAL BRASS	FINISH NATURAL
DRAWN BY M.L. [redacted]	APPROVED BY
DATE 11-13-54	SCALE 4" = 1"
NEXT ASSEMBLY	MODEL

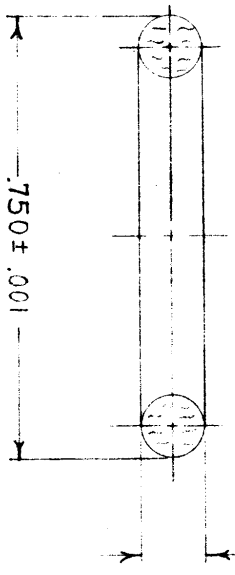
CAPSULE BODY

NO	DATE	REVISIONS	BY

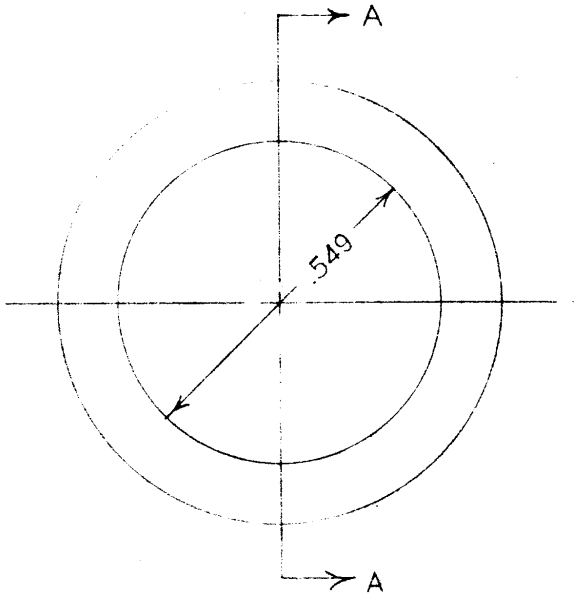
UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ±

DWG SIZE	DWG NO	ISSUE
A	T-266-413	

SHEET 16 OF 23 SHEETS



SECTION A-A



NOTE
MATERIAL: THIOKOL, PRECISION RUBBER
COMPANY'S GRADE NO. 1000-70

PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
MATERIAL SEE NOTE		FINISH NATURAL	
DRAWN BY M.L.C.		APPROVED BY	
DATE 1-29-55		SCALE 4"=1"	
NEXT ASSEMBLY		MODEL	

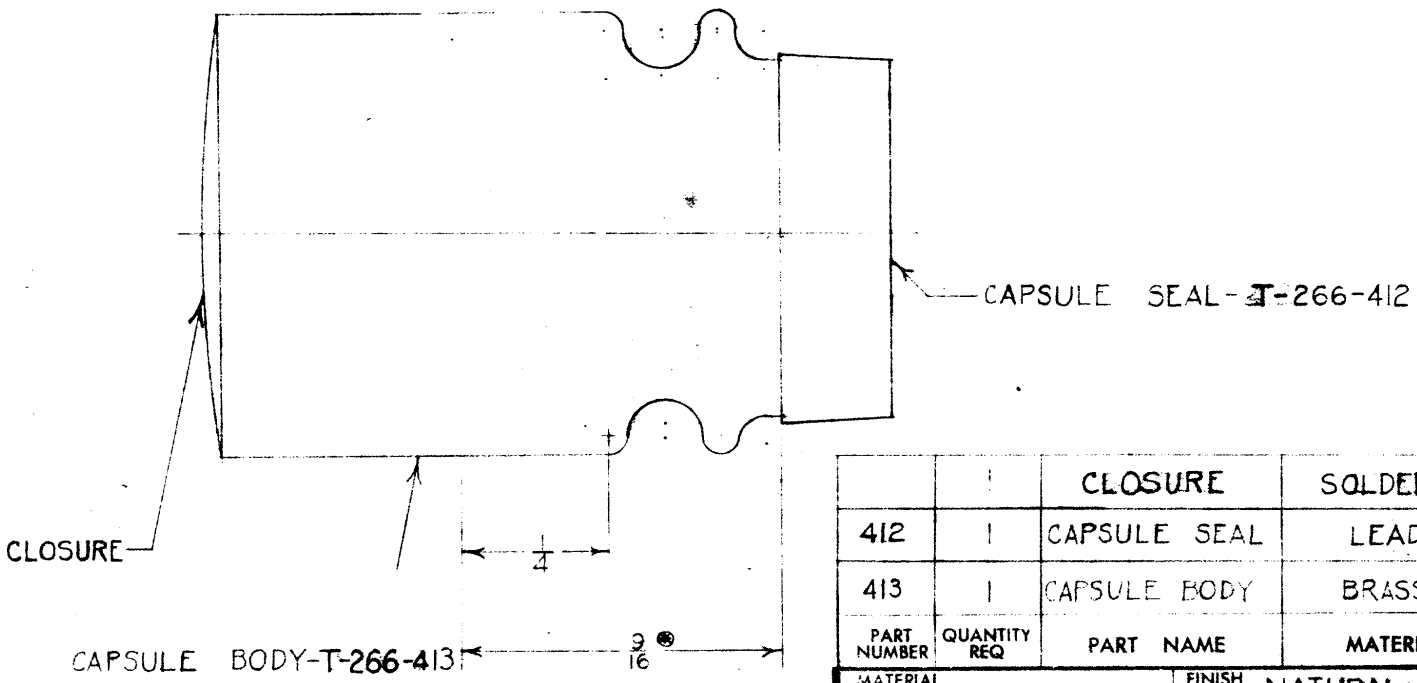
CAPSULE O-RING

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ±.005 ANGLES ±

DWG SIZE	DWG NO	ISSUE
A	T-266-414	

SHEET 17 OF 23 SHEETS



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
	1	CLOSURE	SOLDER
412	1	CAPSULE SEAL	LEAD
413	1	CAPSULE BODY	BRASS

MATERIAL	FINISH NATURAL + ⊛
DRAWN BY M.L.C[redacted]	APPROVED BY
DATE 1-8-55	SCALE 4"=1"
NEXT ASSEMBLY	MODEL

NOTE
⊛ PAINTED TT-L-58

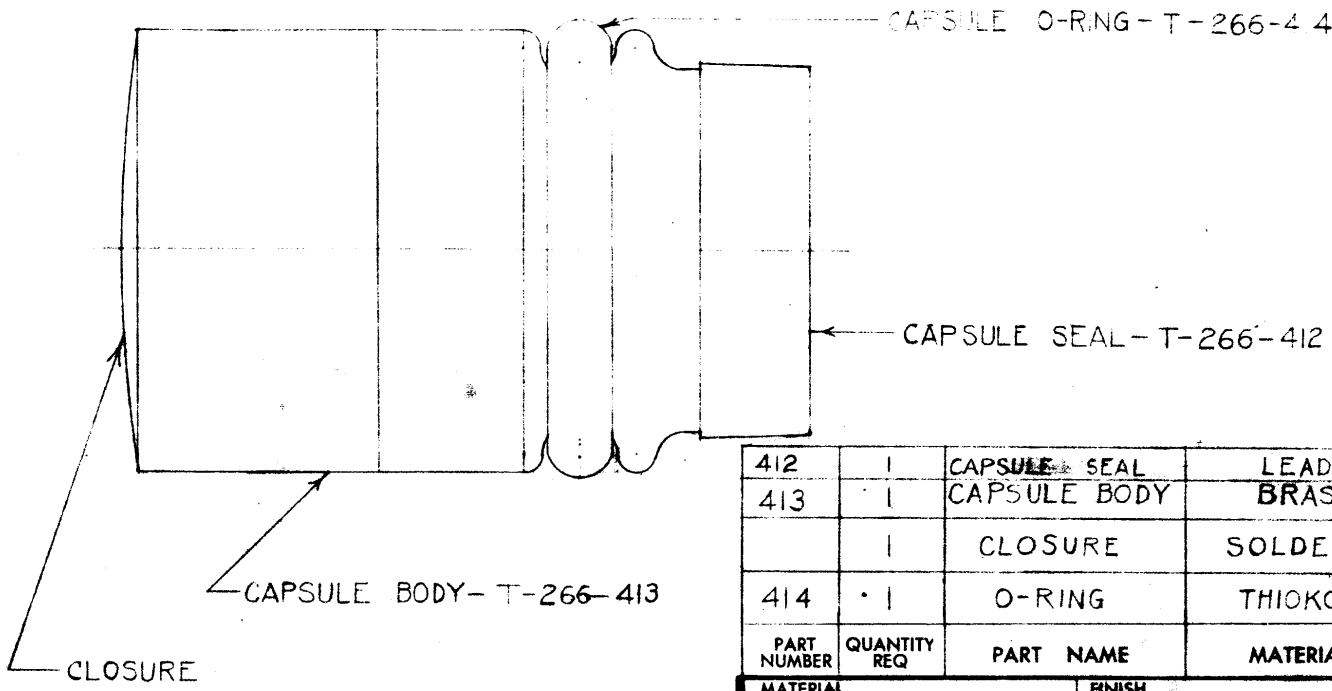
CAPSULE BODY ASSEMBLY

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 1/32 DECIMALS ± ANGLES ±

DWG SIZE	DWG NO	ISSUE
A	T-266-300	

SHEET 18 - OF 23 SHEETS



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
412	1	CAPSULE SEAL	LEAD
413	1	CAPSULE BODY	BRASS
	1	CLOSURE	SOLDER
414	1	O-RING	THIOKOL

MATERIAL	FINISH
DRAWN BY M.L.C. [redacted]	APPROVED BY
DATE 1-8-55	SCALE 4"=1"
NEXT ASSEMBLY	MODEL

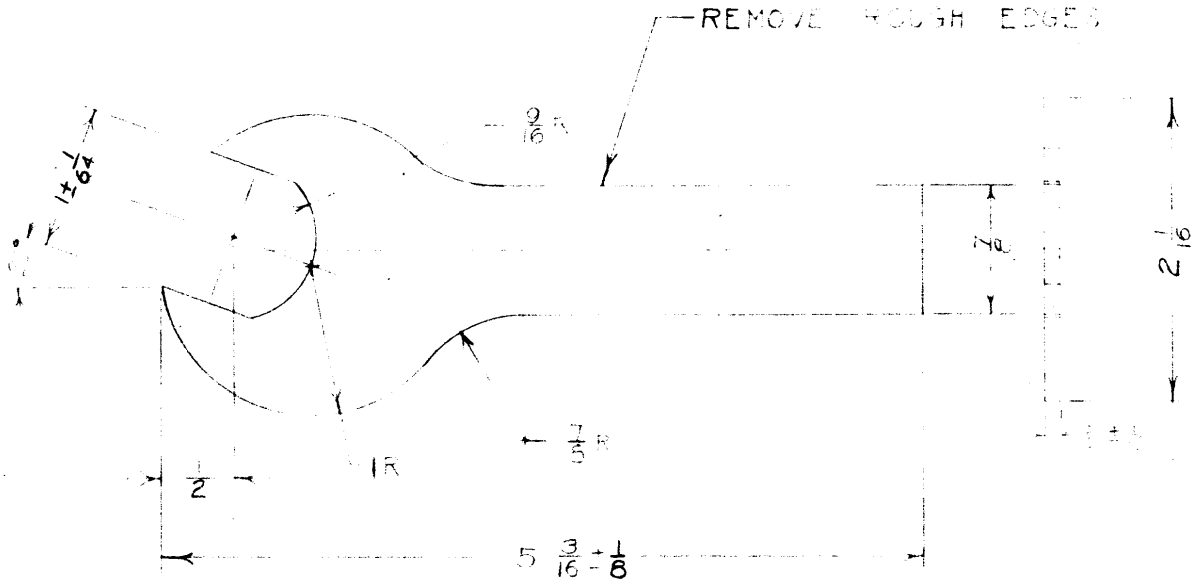
CAPSULE

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ± ANGLES ±

DWG SIZE	DWG NO	ISSUE
A	T-266-201	

SHEET 19 OF 23 SHEETS



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL

MATERIAL FED. SPEC. QQ S-636 FINISH MIL-E-10687A, #331

DRAWN BY M.L. C[redacted]

DATE 1-8-55 SCALE 1"=1"

NEXT ASSEMBLY

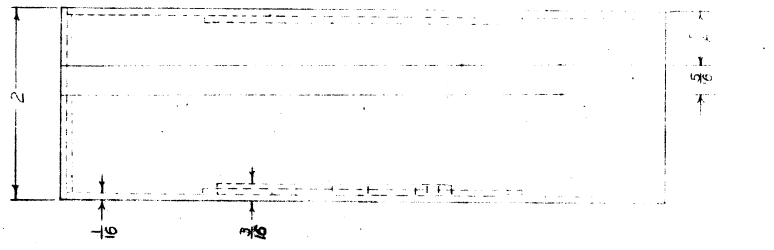
WRENCH

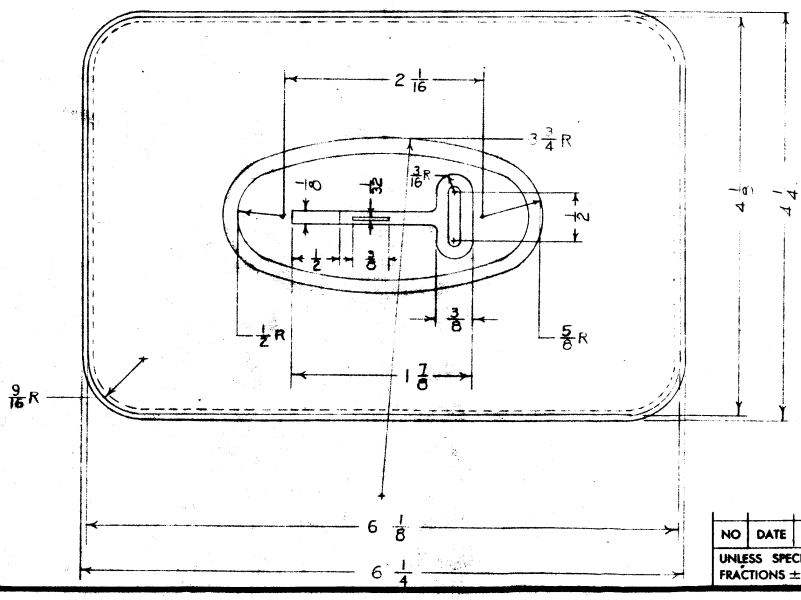
NO.	DATE	REVISIONS	BY

UNLESS OTHERWISE SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 1/16 DECIMALS ± ANGLES ± 3°

DWG SIZE	DWG NO	ISSUE
A	T-266-415	

SHEET 20 OF 23 SHEETS





NO	DATE	REVISIONS	BY

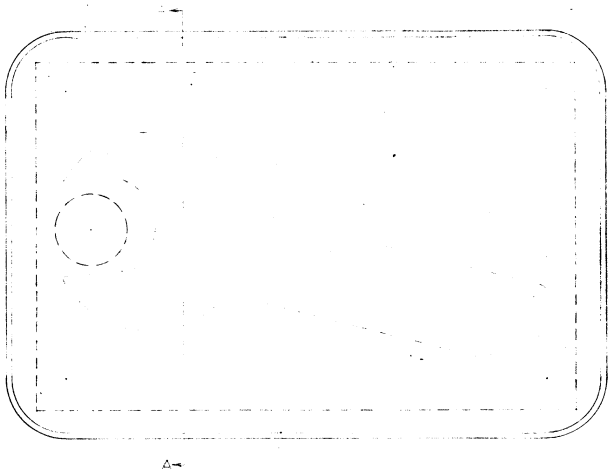
UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ± ANGLES ±

PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
MATERIAL	STEEL	FINISH	MIL-E-10687A NO.331
DRAWN BY	M.L.C.	APPROVED BY	
DATE	2-5-55	SCALE	1"=1"
NEXT ASSEMBLY		MODEL	

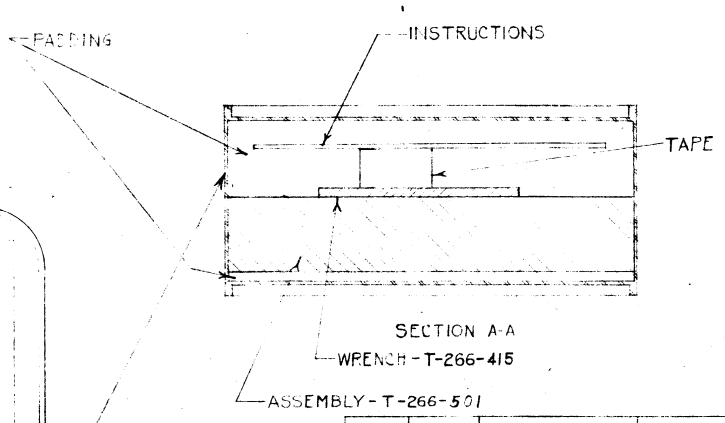
CAN

DWG SIZE	DWG NO	ISSUE
B	T-266-416	

SHEET 21 OF 23 SHEETS



TOP



PART NUMBER	QUANTITY REQ	PART NAME	MATERIAL
		PADDING	COTTON
	1	INSTRUCTIONS	PAPER
	1	TAPE	JAN-P-127-II-B
415	1	WRENCH	QQ-S-636
416	1	CAN	STEEL
501	1	ASSEMBLY	

MATERIAL	FINISH
DRAWN BY M.L.C.	APPROVED BY
DATE 2-2-55	SCALE 1" = 1"
NEXT ASSEMBLY	MODEL

25X1

PACKAGE

NO	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± DECIMALS ± ANGLES ±

DWG SIZE	DWG NO	ISSUE
B	T-266 - 501	

SHEET 23 OF 23 SHEETS

~~CONFIDENTIAL~~

Conference on 18 January 1956 - Joe, Bill, Don, HE

Subject: Agreement on Procedures on MK 2 Delay - 1000 Unit Production

1. [redacted] 25X1

2. Music wire spring will be used.

3. [redacted] 25X1
however, decision on whether or not [redacted] will be 25X1
used in package will be made at a later date.

4. The safety clip will be modified by placing a hole on each ear, using a 3" loop between the holes. The loop shall be made up of cord similar to that used on the AC Delay.

5. Spacers in package shall be approximately .025" chipboard.

6. A small radius will be placed on the internal corner of the shoulder of the striker body.

7. No threads of either the body or cap shall be painted.

8. The inside of the top of the cap shall be painted.

9. The small cavity of the body shall not be painted.

10. The safety clip shall be painted black, using quick drying enamel of the same type as that used upon the body.

11. The inside of the can shall not be painted.

12. A pull test shall be made upon the safety clip and such test shall be written in the specifications.

13. The normal butyl lactate capsule shall be omitted.

14. The colors of the dyes in the solvents shall be changed to make them correspond more closely with the colors of the markings.

15. There shall be no instruction sheet in the package.

16. Luting compound shall be omitted.

17. The large washer shall be changed to an "O" ring and the small washer shall not be changed. Material for washers and "O" ring shall be Thiokol.

~~CONFIDENTIAL~~

18. The can shall have one key attached to it.

✓19. Paragraph 8.1 of the specifications shall be changed to read 10% inspection.

✓20. A pull test shall be devised for the safety, and Paragraph 8.3.1 shall be reqritten accordingly. 10% inspection shall be performed under Paragraph 8.3.1.

✓21. Paragraph 8.3.2 shall be changed so that ten of the tests shall be fired in such a way as to ascertain whether or not the firing pin will be completely expelled. The remainder of the tests shall be made in the inverted position in such a way that the firing pin shall cause a definite impression to be made upon the lead test plate in our standard testing fixture when it contacts the fixture at a distance of 1/2" from the end of the unit.

✓22. Omit Paragraph 8.5.1. In lieu of Paragraph 8.5.1 the quality of the heat sealing of the liner shall be spot checked.

23. Joe will loan us the heat sealer.

✓24. In reference to Paragraph 8.5.2. Inspect cans on closing but do not perform any destructive testing.

✓25. In reference to Paragraph 8.5.3. Each inspection should also include screwing down the cap to the safety to insure that in safety position, the capsule will not be damaged.

26. Joe will recommend specifications for the plating on the cans.

✓27. We will perform all inspections under the supervision of customer.

28. Joe will take the final package specifications under consideration.

8.4.4? ✓29. In reference to Paragraph 8.3.2. 2% of the capsules shall be put through a rupture test at 160°F.

vacuum test

Joe stated that the phosphorus bronze spring used in the material study should be compressed in testing fixtures so that the following tests may be performed:

10 tests for 3 months; 10 tests for 6 months; 10 tests for 12 months; 10 tests for 2 years; 10 tests cycle -65° -165°F. for 2 weeks; 10 tests for an indefinite period.

The Miniature Delay proposal was rewritten.

DHlaw

CONFIDENTIAL

CONFIDENTIAL